DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

HANDBOOK

B.E. IN INDUSTRIAL & PRODUCTION ENGINEERING

JSS TECHNICAL INSTITUTIONS CAMPUS MYSORE-570006

2024-2025

1. About JSS Science and Technology University

Karnataka's share in National GDP is around 6%. The character of the state economy has drastically changed from primarily agrarianin1956towards industrial & serviceeconomy in2010. GOK's Vision (http: // www .karunadu . gov . in / spb / Documents / KVD 15th % 20 Jan % 20English.pdf) is to develop a vibrant knowledge society and achieve a sustainable and orderly process of industrializationby enhancing humancapabilities. In accordance with GOK's Vision JSS Mahavidyapeetha has established JSS Science and Technology University at Mysuru.

JSS Science and Technology University is one of the recent additions to the institutions administered by JSS Mahavidyapeetha, and is the second University being established besides a Medical University at Mysuru. India's higher education system is on the verge of major reforms and JSS Science and Technology University has been established envisioning to create a bright future and a desired learner centric eco-system and transform into a futuristic global University. The Availability of skilled human resources and trained technical manpower in engineering and technology is a major reason for growing investments in the state. In this context higher education system has a key role and more particularly JSS S&T U with an objective of transforming the students at all levels of higher education including research and innovation with measures to improve quality of workforce.

Education has always been India's prime priority. Mysuru is the holy land for educational institutions. Education is the basic necessity for wellbeing and development of a Nation. A well-established highereducation system formsthe flagship fortransformingto meetthe global needs. Yet,a large chunk of people in India need literacy and many more need to acquire employable skills to suit the emerging modern India. Hence JSS S&T University is committed to deliver high quality educational opportunities for youth and transform not only its neighborhood but offer courses to equip aspiring youth to meet the global needs of industry in every sector.

JSS S&T University is articulated with the following Master plan.

Our Mission is to establish one of the world's great broad-based sustainable value driven research-intensive university and integrate nation building.

The proposed strategy identifies our priorities for the next five years, during which we'll focus our resources on maintaining existing and developing new, leading activities. We'll improve our standing nationally and internationally, while meeting needs of Industry, and students. The strategy focuses on three main themes:

National Focus:

We'll orient our efforts towards overall developmentof students', aligning our investments with our strategic priorities to cater to the Nations' Vision. We'll streamline our systems and processes to make the most of our resources, and minimize bureaucracy.

Global reach:

We'll broaden our efforts to meet the global needs of the larger world community with focusedpriorities including a multi-cultural community of students and staff and become a truly international university. We'll prepare students for diversified technological environments worldwide, and develop international alliances and partnerships.

Multi-disciplinary approaches.

We'll strategically provide encouragement to multi-disciplinary approaches by supporting and developing networks of students, faculty and researchers worldwide. We'll create world leading, multi- disciplinary, learning centers, research institutes that meet our Industries and funders' strategic needs. The vision of JSS Science and Technology University is to be an effective instrument in enhancement of knowledge in the Society and thus the social transformation.

Our Strategic priorities includes

- Prominent National Status
- Quality Teaching & Learning
- Research of International Repute
- State of the art infrastructure of International Standard:
- Open access to knowledge through Distance Education
- Collaborations& MOU

JSS Science and Technology University strategies to utilize the very best of education technology, optimize teaching methods, and encourage new interdisciplinary research programmes that help connect teaching and research, including applied and action research projects.

It is Proposed to offer these New Academic Programs

1. Information technology and Telecommunication
2. Infrastructure Engineering and Management
3. Systems Engineering and Manufacturing
4. Energy and Environment engineering
5. Biosciences Engineering
6. Transportation, logistics and Freight forwarding
7. School of Design.
8. Corporate finance and Data Sciences
9. Academic Leadership Institute.

The Organizational strength

The ability of nations and people to learn, to adapt the lessons to their own context quickly, and to translate learning into action, are the critical components of successful development in a globaleconomy that increasingly relies on knowledge and information and learning has, in fact, always been at the core of economic change (1996 annual report of the World Bank, Economic Development Institute, President James Wolfenson).

The point is of obvious importance in a world characterized by rapid growth in trade and investment; a dizzying rate of technological change; increased economic integration among nations; an uncoupling of natural resources from development as a result of new materials and knowledge-based substitutes; globalization of industries; and more open competition.

Technology, as we understand has several facets, all of which are powerful drivers of change. New materials, biotechnology innovations, and robotics are but a few of them. However, the most profound of all is what is often called telematics the convergence and explosive growth anddevelopment of the information and communication technologies. Professional education effort of JSS Mahavidyapeetha is laudable in the present context. The prominent contributors being JSS Technical Education division, JSS University and the recently established JSS Science and Technology University. Excellence in its entire education system is very evident with thrust on improvements in quality and relevance of content and delivery at all levels with systemic improvements like, synergy between research & teaching, flexibility in choice of courses with in the institution and across institutions including universities abroad through exchange of students(shift from *plate meal* approach to *cafeteria* approach) emphasizing the need for cross-disciplinary courses, evaluating students continuously on the basis of understanding & application of knowledge and academia-industry interface and building centers of excellence in the higher education system.

Availability of skilled human resources including trained technical manpower in engineering and technology is major reason for growing investments in the state. In this context, higher educationsystem has a key role and more particularly JSS Mahavidyapeetha which has developed a brand image over the last six decades of its existence.

Vision of JSSSTU

- Advancing JSSS&T University as a leader in education, research and technology on the international arena.
- To provide the students a universal platform to launch their careers, vesting the industry and research community with skilled and professional workforce.

- Accomplishing JSSS&T University as anepicenter for innovation, center of excellence for research with state of the art lab facilities.
- Fostering an erudite, professional forum for researchers and industrialist to coexist and to work cohesively for the growth and development of science and technology for betterment of society

Mission of JSSSTU

- Education, research and social outreach are the core doctrines of JSS S&T University that are responsible for accomplishment of in-depth knowledge base, professional skill and innovative technologies required to improve the socio economic conditions of the country.
- Our mission is to develop JSS S&T University as a global destination for cohesive learning of engineering, science and management which are strongly supported with interdisciplinary research and academia.
- JSS S&T University is committed to provide world class amenities, infrastructural and technical support to the students, staff, researchers and industrial partners to promote and protect innovations and technologies through patents and to enrich entrepreneurial endeavors.
- JSS S&T University core mission is to create knowledge led economy through appropriate technologies, and to resolve societal problems by educational empowerment and ethics for better living.

VISION of SJCE

"Be an international leader in engineering education, research and application of knowledge to benefit society globally".

MISSION of SJCE

- "To synergistically develop high-quality man power and continue to stay competitive in tomorrow's world".
- To foster and maintain mutually beneficial partnerships with our alumni, industry, state and central governments through public services assistance and collaborative research".
- "To create empowered individuals with sense of identity".

VISION OF THE INDUSTRIAL & PRODUCTION DEPARTMENT

1. To be reputed globally by imparting quality technical education through in-depth knowledge, professional ethics and social responsibilities for the betterment of the society.

2. To create a state of the art facilities to promote academic, research and professional activities for teaching and student communities.
3. To provide opportunities for students to launch their career in specialized areas of research that caters the needs of Industry community.

To produce quality Engineers with excellent academic, behavioral, managerial and innovative skills to meet the challenges posed in the rapidly changing Industry scenario.

MISSION STATEMENT OF THE DEPARTMENT

M1: To design the program curriculum to cater the needs of the rapid technological advancement and to upgrade the infrastructure and laboratory facilities in tune withthe curriculum requirements.

M2: To build a close liaison with the industries for in house theory and practical training to the teaching and students fraternities in order to enhance their skills and knowledge in the areas of Industrial Engineering, Manufacturing and Management.

M3: To produce quality Engineers with excellent academic, behavioral, managerial and innovative skills to meet the challenges posed in the rapidly changing Industry scenario.

ABOUT THE DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Brief introduction to the department highlighting Programmes offered (UG&PG)

Industrial and Production Engineering Department came into existence in the year 1980 under the umbrella of JSS Mahavidyapeetha. It became a grant-in-aid department in the year 1983. Ever since its inception, the department has grown from strength to strength over the years interms of intake of students. The program was started in 1980.

The department has an intake of over 60 students. The department has a highly qualified, dedicated faculty team. The department has very good infrastructure facilities. The department has highly sophisticated laboratories Viz. CAD/ CAM laboratory, Software Applications laboratory, Metrology laboratory, Industrial Engineering laboratory cater to carry out academic and research activities. Till date, the department has produced 10 PhDs and 9 research scholars are pursuingPh.D. The department has been accredited three times by the National Board of Accreditation(NBA).

The department has produced distinguished alumni over the years who are holding top positions in organizations and have brought laurel to the institution. The students' placement record is excellent over the years. Students have placed in esteemed organizations Viz. Mercedes Benz, Toyota, Robert Bosch, TVS, RR Donnelley, Schneider Electric, TCS, and Accenture etc. Department is constantly encouraging students to attend internship programs in reputed companies and to participate in extracurricular activities as well. Students are also encouraged to do innovative projects by the department.

Some of the projects carried out by the students like PACE have received international acclaim and won prizes to the department. The Department has been awarded with AICTE MODROB grant of Rs.11,00,000/-for modernization of Computer Aided Design Laboratory. Under this scheme Department has procured UGS-NX suite.

List the programs offered from the department–B.E (Industrial & Production Engineering)

Department faculty Details:

Sl. No.	Name	Designation	Research Area	Email(UniversityEmail)
1.	Dr. Savitha M	Professor	Composite Materials, Smart Materials.	savitham@jssstuniv.in
2.	Dr. Dayakar G Devaru	Professor	Energy Engineering, Lean Manufacturing, Operations Research	dayakar.devaru@jssstuniv.in
3.	Mr. K. Vidyadhar Shetty	Professor of Practice	Industry experienced – Industry Expert	vidyadhar@jssstuniv.in
4.	Dr Yerriswamy W	Associate Professor	Quality control & Engineering, Statistical Analysis	wyerriswamy@jssstuniv.in
5.	Dr. Manjunatha B	Associate Professor	Product Design and Manufacturing, TPM, Materials Management	manjub@jssstuniv.in
6.	Dr. Skanda M G	Associate Professor	Engineering Management, Human Factors Engineering.	skanda.rao@jssstuniv.in
7.	Mrs. Sowmya C	Assistant Professor	Production Engineering, Lean Manufacturing and TRIZ	sowmyac@jssstuniv.in
8.	Dr Vanishree Beloor	Assistant Professor	Production Management, Operations research	**vanishreeblr@jssstuniv.in**
9.	Dr. Roopa D.N	Assistant Professor	Engineering Management, Organizational Behavior	roopadn@jssstuniv.in
10.	Mr Santosh.C	Assistant Professor	Machine Design , CompositeMaterials	santoshc@jssstuniv.in

Laboratory facilities:

Name of the Laboratory	Name of the Major Equipment
Metrology & Measurements	· Profile Projector · Talyrond · Autocollimator · Tool Makers Microscope · Dial Micrometer · Optical Flats · Levelling Press · Gear Tooth Micrometer · Spline Micrometer · Deep Hole Dial Depth Gauge · Dial Micrometer · V-AnvilMicrometer · Magnetic Check Profile Projector Vernier Calipers · Dial Calipers · Digital Calipers
Industrial Engineering Laboratory	· Modern Tread Mill · Ergometer · Work study Professional software.
CAD/CAM/CAE	· UGS NX Bundle–75Seat License · Solid Edge Student version · ANSYS10 Student Edition · CNCEXSL Simulation software–10 Seat License · CADEM–15 Seat License
Software Applications/Operations Research Laboratory	· JMP- Statistical software · Win QSB(Windows Quantitative Systems for Business) – open source Software

Research & Consultancy

Sl. No.	Name	Area of Specialization
1.	Dr. Savitha .M.	Composite Materials, Smart Materials.
2.	Dr.Dayakar G.Devaru	Energy Engineering, Lean Manufacturing, Operations Research
3.	Mr. K Vidyadhar Shetty	Professor of Practice – Industry related
4.	Dr.Manjunatha B	Product Design and Manufacturing, TPM
5.	Dr.Skanda M G	Engineering Management, Human Factors Engineering.
6.	Dr Yerriswamy W	Quality control & Engineering, Statistical Analysis
7.	Dr Vanishree Beloor	Production Management, Operations research
8.	Dr. Roopa D.N	Engineering Management, Organizational Behavior

Employment Opportunities: The placement opportunities are promising. At present,43 students out of 51 students have been placed in the 2022 batch and 40 students have been placed out of 61 students in the ongoing 2023 batch so far in many promising industries.

Industry-Institute-Interaction MoUs:

MOU with GTTC & MOU with UD trucks

MOA with DASSAULT Systems

Board of Studies

Sl. No.	Name of Member	Designation
1.	Dr. C .Nataraju	Principal
2.	Dr.Pushpa Tuppad	Dean Academic
3.	Dr.Savitha M	Chairperson
4.	Dr.Dayakar G Devaru	Members
5.	Dr.Manjunatha B	Members
6.	Dr.Skanda M G	Members
7.	Ms.Sowmya C	Members
8.	Dr Yerriswamy W	Members
Sl. No.	**Name of Member**	**Designation, Organization/Industry/ Institute, contact details**
1	Dr Srinath M S	Professor in Dept of I&PE, MCE, Hassan. srinadme@gmail.com M: 8277421917
2.	Dr Divakar H N	Professor & HOD Dept of I&PE, NIE, Mysuru hndivakar@nie.ac.in M: 8861276367
3.	Mr. VijayKumar	Designation: GM-Manufacturing Excellence, TVS India Pvt.Ltd, Hosur Email: pvk@sacl.co.in M: 9944442158
4.	Mr Aniruddha Poornachandra	Sr. Design Engineer, Mercedes-Benz, Bangalore Aniruddha.poornachandra@mercedes-benz.com M: 9972645739
5.	Mr Vinay D C	Director, Marketing Business development & Engineering, Shanthala sypherocast Private Limited. Shivmoga vinay@shanthalaspherocast.com M: 7899733388
6.	Mr Naveen Prasad	Principal, Universal Group of Institutions, Ramohalli Post, Bangalore puc@universalinstitutions.com M: 9686769344

#	Program Outcomes:-The Graduates will be able to:
PO1:	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2:	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3:	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4:	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5:	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6:	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7:	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8:	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9:	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10:	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11:	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

#	Program Educational Objectives:-The Graduates will be able to:
PEO–1	Graduates get employed in professions related to Industrial and Production Engineering adopting and adapting to advances in technology and management.
PEO–2	Graduates pursue advanced studies at Institutions of higher learning to engage in research with an inclination towards life-long learning.
PEO–3	Graduates become successful professionals in a challenging environment by becoming successful entrepreneurs keeping in mind the ethical responsibilities

#	Program Specific Outcomes:-The Graduates will be able to:
PSO-1	To create qualified budding, versatile and multifaceted Engineers to solve real- world problems with good theoretical and practical knowledge arising in the areas of Industrial Production Engineering.
PSO-2	To imbibe confidence in students to become entrepreneurs of the future.
PSO-3	To develop students with excellent presentation skills to take up innovative projects of industries.

Program Outcomes–Competencies–Performance Indicators of Industrial & Production Engineering Department

List of competencies and associated performance indicators for each of the PO in Industrial& Production Engineering Program.

PO1: Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

Competency	Indicators
1.1 Demonstrate Competence in mathematical modelling	1.1.1 Apply mathematical techniques such as calculus, linear algebra and statistics to solve problems 1.1.2 Apply advanced mathematical techniques to model and solve mechanical engineering problems like Simplex Method, Transportation problems etc.
1.2 Demonstrate Competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problems like Kinematics of Machines, Dynamics of Machines, Fluid Mechanics etc.
1.3 Demonstrate Competence in	1.3.1 Apply fundamental engineering concepts like ductility, brittleness, Solidification etc to solve engineering problems

engineering fundamentals	
1.4 Demonstrate competence in specialized engineering knowledge to the program	1.4.1Apply Mechanical engineering concepts to solve engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

Competency	Indicators
2.1 Demonstrateanability to identify and formulate complex engineering problem	2.1.1 Articulate problem statements and identify objectives 2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into inter connected sub-problems 2.2.2 Identify, assemble and evaluate information and resources. 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions 2.2.4 Compare and contrast alternative solution processes to select the best process.
2.3 Demonstrate an ability to formulate and interpret a model	2.3.1 Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy. 2.3.2 Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4 Demonstrate an ability to execute a solution process and analyze results	2.4.1 Apply engineering mathematics and computations to solve mathematical models 2.4.2 Produce and validate results through skillful use of contemporary engineering tools and models 2.4.3 Identify sources of error in the solution process, and limitations of the solution. 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

PO 3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

Competency	Indicators
3.1 Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1 Recognize that need analysis is key to good problem definition 3.1.2 Elicit and document, engineering requirements from stakeholders 3.1.3 Synthesize engineering requirements from a review of the state-of-the-art 3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE. 3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues 3.1.6 Determine design objectives, functional requirements and arrive at specifications
3.2 Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions 3.2.2 Build models/prototypes to develop a diverse set of design solutions 3.2.3 Identify suitable criteria for the evaluation of alternate design solutions
3.3 Demonstrate an ability to select an optimal design scheme for further development	3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development 3.3.2 Consult with domain experts and stake holders to select candidate engineering design solution for further development
3.4 Demonstrate an ability to advance an engineering design to defined end state	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources) 3.4.2 Generate information through appropriate tests to improve or revise the design

PO 4: Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

Competency	Indicators
4.1 Demonstrate an ability to conduct investigations of technical issues consistentwiththeirlevel of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles.
4.2 Demonstrate an ability to design experiments to solve open-ended problems	4.2.1 Design and develop an experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives

4.3 Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and to collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

Competency	Indicators
5.1 Demonstrate an ability to identify/ create modern engineering tools,techniquesand resources	5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities 5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2 Demonstrate an ability to select and apply discipline- specific tools,techniquesand resources	5.2.1 Identify the strengths and limitations of tools for(i)acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. 5.2.2 Demonstrate proficiency in using discipline-specific tools
5.3 Demonstrate an ability to evaluate the suitability an d limitations of tools used to solve an engineering problem	5.3.1 Discuss limitations and validate tools, techniques and resources 5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 6: The engineer and world: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7.

Competency	Indicators
6.1 Demonstrate an ability to describe Engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2Demonstrate an understanding of Professional engineering regulations, legislation and standards	6.2.1Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

Competency	Indicators
7.1 Demonstrate an understanding of theimpact of engineering and industrial practices on social,environmentalandin economic contexts	7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity 7.1.2 Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2 Demonstrate an ability to apply principles of sustainable design and development	7.2.1 Describe management techniques for sustainable development 7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

Competency	Indicators
8.1 Demonstrate an ability to recognize ethical dilemmas	8.1.1Identify situations of unethical professional conduct and propose ethical alternatives
8.2 Demonstrate an ability to apply the Code of Ethics	8.2.1 Identify tenets of the ASME professional code of ethics 8.2.2 Examine and apply moral & ethical principles to known case studies

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

Competency	Indicators
9.1 Demonstrate an ability to form a team and define a rolefor each member	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2 Demonstrate effective individual and team operations--communication, problem- solving, conflict resolution and leadership skills	9.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.2.2 Treat other team members respectfully 9.2.3 Listen to other members 9.2.4 Maintain composure in difficult situations
9.3 Demonstrate success in a team-based project	9.3.1Present results as a team, with smooth integration of contributions from all individual efforts

PO 10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

Competency	Indicators
10.1 Demonstrate an ability to comprehend technical literature and document project work	10.1.1 Read, understand and interpret technical and non-technical information 10.1.2 Produce clear, well-constructed, and well-supported written engineering documents 10.1.3 Create flow in a document or presentation –a logical progression of ideas so that the main point is clear
10.2 Demonstrate competence in listening, speaking, and presentation	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others 10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3 Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation

PO 11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performanceofan engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1Analyze and select the most appropriate proposal based on economic and financial considerations.

11.3 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Quality Policies

To provide global standards of excellence in teaching and to remain accountable in our core and support functions, through processes of self-evaluation and continuous improvement.

Enhancing the competence of the faculty to a very high level and to make them adopt all modern and innovative methods in teaching-learning process. Inculcating moral and ethical values among the students and staff. Collaborating with industry, other institutions and organizations for promoting Research and Development programme for the overall growth of the student of the student.

Scheme for BE Programs

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week & 2 Hours Practical (Lab)/week	0.5 credits & 1 credit

B. Requirement of credits: For student to be eligible to get Bachelor of Engineering (B.E.) Degree should have credit of 160 for regular students and 122 credits for lateral entry students

C. Course wise credit distribution

Description	I	II	III	IV	V	VI	VII	VIII	Total
Basic Science courses	8	8	3	3	-	-	-	-	**22**
Engineering Science courses including workshop, drawing, basics of electrical/ mechanical/ computer etc.	11/8	8/11	-	-	-	-	-		**19**
Humanities and Social Sciences and Management courses	0/3	3/0	2	2	-	-	3	-	**10**
Professional core courses	-	-	18	15	13	13	-	-	**59**
Professional core courses Lab	-	-	1.5	1.5	1.5	1.5	-	-	**6**
Professional Elective courses relevant to chosen specialization/ branch	-	-	-	-	6	6	6	3	**21**
Open Elective courses from other technical and /or emerging subject	-	-	-	3	3	3	-	-	**9**
Project work, seminar and internship in industry or elsewhere	-	-	-	-	-	-	4	10	**14**
Total	19	19	24.5	24.5	23.5	23.5	13	13	**160**

Semester-wise credit distribution

Regular Students		Lateral Entry Students	
Semester	**Credits**	**Semester**	**Credits**
I	19	-	-
II	19	-	-
III	24.5	III	24.5
IV	24.5	IV	24.5
V	23.5	V	23.5
VI	23.5	VI	23.5
VII	13	VII	13
VIII	13	VIII	13
TOTAL	160	TOTAL	122

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2024-25)

SCHEME OF TEACHING AND ASSESSMENT FOR B.E.

Category Code:	**Teaching Departments**	
L: Lecture/ Theory T: Tutorial P: Integrated Practical/Practice SDA: Skill Development Activities BSC: Basic Science Course ESC: Engineering Science Course HSMC: Humanity and Social Science and Management Course PCC: Professional Core Course OEC: Open Elective Course PCCL: Professional Core Course Laboratory PWC: Project Work Course	MA: Mathematics PH: Physics CH: Chemistry HU (KA): Kannada HU (EN): English BT: Biotechnology CS: Computer Science and Engineering CT: Construction Technology and Management CV: Civil Engineering	EC: Electronics and Communication Engineering EE: Electrical and Electronics Engineering EI: Electronics and Instrumentation EV: Environmental Engineering IP: Industrial and Production Engineering IS: Information Science & Engineering ME: Mechanical Engineering PS: Polymer Science and Technology PD: Parent Department

- Open elective course is open to all the students excluding the students of parent department
- Students can take SWAYAM/NPTEL courses from 3rd semester to 6th Semester
- SWAYAM/NPTEL courses shall be offered to students with the approval of the department.
- Students who wish to consider the SWAYAM/NPTEL course in the grade card shall submit the qualification certificate to the University SWAYAM/NPTEL coordinator certified by the concerned Head of the Department through Dean (Engineering & Technology).
- The Head of the Department shall mention the consideration of SWAYAM/NPTEL course as a replacement course for the Professional Elective course offered either in 7th or 8th semester.
- The Head of the Department shall prepare the list of courses offered under SWAYAM/NPTEL with the approval of Board of Studies and it should be minimum of 12 weeks (12 weeks or 8+4 or 4+4+4 or any other combination) to qualify as a 3-credit course.
- Students who could not qualify/complete the SWAYAM/NPTEL course should register for Professional Elective courses offered in 7th or 8th semester.
- Team size for the final year project work shall be 2 to 4 students.
- Cycle definition
  - **Cycle 1: CS, EC, EE, EI, IS, CSBS**
  - **Cycle 2: CV, CT, EV, IP, ME, BT, PS**

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2024-25)

SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Semester I: Physics cycle

Sl. No.	Course code	Course Title	Category code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	Total		CIE	SEE	Total	
1	24MA110	Engineering Mathematics –I	BSC	MA	MA	3	1	-	4	4	40	60	100	03
2	24PH110	Engineering Physics	BSC	PH	PH	3	-	2	5	4	40	60	100	03
3	24ME11x	Elective 1 – Mechanical Engineering	ESC	ME	ME	3	-	-	3	3	40	60	100	03
4	24EE110	Elements of Electrical Engineering	ESC	EE	EE	3	-	-	3	3	40	60	100	03
5	24CS11x	Elective 2 - Introduction to Programming	ESC	CS/IS	CS/IS	3	-	2	5	4	40	60	100	03
6	24HU110	Kannada	HSMC	HU (KA)	HU (KA)	2	-	-	2	0	40	-	40	-
7	24HU120	Innovation & Design Thinking	ESC	PD	PD	2	-	-	2	1	20	30	50	02
8		NSS/NCC/SDA								-	-	-	-	-
Total										**19**	**260**	**330**	**590**	-

Elective 1 – Mechanical Engineering		Elective 2 - Introduction to Programming	
24ME111	Elements of Mechanical Engineering	24CS111	C Programming
24ME112	Introduction to Mechatronics and Robotics	24CS112	Object Oriented Programming using C++
		24CS113	Python Programming

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2024-25)

SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Semester I: Chemistry cycle

SlNo	Course code	Course Title	Category code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	Total		CIE	SEE	Total	
1	24MA110	Engineering Mathematics –I	BSC	MA	MA	3	1	-	4	4	40	60	100	03
2	24CH110	Engineering Chemistry	BSC	CH	CH	3	-	2	5	4	40	60	100	03
3	24CV110	Engineering Mechanics	ESC	CV	CV	3	-	-	3	3	40	60	100	03
4	24EC11x	Elective 3 – Electronics Engineering	ESC	EC	EC	3	-	-	3	3	40	60	100	03
5	24ME120	Engineering Graphics and Design	ESC	ME	ME	-	1	2	3	2	40	60	100	03
6	24HU11x	Elective 4 – Sustainability/Skill	HSMC	All Dept	HU	2	-	-	2	2	20	30	50	02
7	24HU130	Communication English	HSMC	HU (EN)	HU (EN)	2	-	-	2	1	20	30	50	02
8		NSS/NCC/SDA/Sports/Yoga								-	-	-	-	-
Total										**19**	**240**	**360**	**600**	

Elective 3 – Electronics Engineering		**Elective 4 – Sustainability/Skill Based**	
24EC111	Elements of Electronics Engineering	24HU111	Sustainability Engineering
24EC112	Fundamentals of Robotics and Its Applications	24HU112	Introduction to Cyber Security
24EC113	Sensors and Measurements	24HU113	Human Psychology
		24HU114	Biology for Engineers
		24HU115	Carbon Sequestration

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Semester II: Physics cycle

SlNo	Course code	Course Title	Category code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	Total		CIE	SEE	Total	
1	24MA210	Engineering Mathematics – I	BSC	MA	MA	3	1	-	4	4	40	60	100	03
2	24CH210	Engineering Chemistry	BSC	CH	CH	3	-	2	5	4	40	60	100	03
3	24CV210	Engineering Mechanics	ESC	CV	CV	3	-	-	3	3	40	60	100	03
4	24EC21x	Elective 3 – Electronics Engineering	ESC	EC	EC	3	-	-	3	3	40	60	100	03
5	24ME220	Engineering Graphics and Design	ESC	ME	ME	-	1	2	3	2	40	60	100	03
6	24HU21x	Elective 4 – Sustainability/Skill	HSMC	All Dept	HU	2	-	-	2	2	20	30	50	02
7	24HU230	Communication English	HSMC	HU (EN)	HU (EN)	2	-	-	2	1	20	30	50	02
8		NSS/NCC/SDA/Sports/Yoga								-	-	-	-	-
Total										**19**	**240**	**360**	**600**	

Elective 3 – Electronics Engineering		Elective 4 – Sustainability/Skill Based	
24EC211	Elements of Electronics Engineering	24HU211	Sustainability Engineering
24EC212	Fundamentals of Robotics and Its Applications	24HU212	Introduction to Cyber Security
24EC213	Sensors and Measurements	24HU213	Human Psychology
		24HU214	Biology for Engineers
		24HU215	Carbon Sequestration

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Semester II: Chemistry cycle

Sl. No.	Course code	Course Title	Category code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	Total		CIE	SEE	Total	
1	24MA210	Engineering Mathematics – I	BSC	MA	MA	3	1	-	4	4	40	60	100	03
2	24PH210	Engineering Physics	BSC	PH	PH	3	-	2	5	4	40	60	100	03
3	24ME21x	Elective 1 – Mechanical Engineering	ESC	ME	ME	3	-	-	3	3	40	60	100	03
4	24EE210	Elements of Electrical Engineering	ESC	EE	EE	3	-	-	3	3	40	60	100	03
5	24CS21x	Elective 2 – Introduction to Programming	ESC	CS/IS	CS/IS	3	-	2	5	4	40	60	100	03
6	24HU210	Kannada	HSMC	HU (KA)	HU (KA)	2	-	-	2	0	40	-	40	-
7	24HU220	Innovation & Design Thinking	ESC	PD	PD	2	-	-	2	1	20	30	50	02
8		NSS/NCC/SDA/Sports/Yoga								-	-	-	-	-
Total										**19**	**260**	**330**	**590**	-

Elective 1 – Mechanical Engineering		Elective 2 - Introduction to Programming	
24ME211	Elements of Mechanical Engineering	24CS211	C Programming
24ME212	Introduction to Mechatronics and Robotics	24CS212	Object Oriented Programming using C++
		24CS213	Python Programming

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER: III

Sl. No	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1	24MATDIP310	Foundations of Engineering Mathematics-I	BSC	MA	MA	3	-	-	3	--	-	60	60	03
	24MA311	Engineering Mathematics III	BSC	MA	MA	3	-	-	3	3	40	60	100	03
2	24IP310	Industrial Metrology	PCC	IP	IP	3	-	2	5	4	40	60	100	03
3	24IP320	Theory of Machines	PCC	IP	IP	3	1	-	4	4	40	60	100	03
4	24IP330	Fluid Mechanics	PCC	IP	IP	3	1	-	4	4	40	60	100	03
5	24IP340	Metal Cutting & Machine Tools	PCC	IP	IP	3	-	-	3	3	40	60	100	03
6	24IP350D	Computer Aided Machine Drawing	PCC	IP	IP	1	-	4	5	3	40	60	100	03
7	24IP36L	Metal Cutting & Machine Tools Lab	PCCL	IP	IP	-	-	3	3	1.5	40	60	100	03
8	24HU312	Environmental Studies	HSMC	EV	EV	2	-	-	2	2	20	30	50	02
		NSS/NCC/SDA/SPORTS/YOGA	SDA							-	-	-	-	-
Total										**24.5**	**300**	**450/ 510***	**750/ 810***	

***For lateral entry students**

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER: IV

Sl. No	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1	24MATDIP410	Foundations of Engineering Mathematics-II	BSC	MA	MA	3	-	-	3	-	-	60	60	03
	24MA411	Engineering Mathematics IV	BSC	MA	MA	3	-	-	3	3	40	60	100	03
2	24IP410	Material Science & Metallurgy	PCC	IP	IP	3	-	2	5	4	40	60	100	03
3	24IP420	Mechanics of Materials	PCC	IP	IP	3	1	-	4	4	40	60	100	03
4	24IP430	Elements of Production Engineering	PCC	IP	IP	3	-	2	5	4	40	60	100	03
5	24IP440	Thermal Engineering	PCC	IP	IP	3	-	-	3	3	40	60	100	03
6	24IP45XOE	Open Elective-I	OEC	IP	IP	3	-	-	3	3	40	60	100	03
7	24IP46L	Computer Aided Design Lab	PCCL	IP	IP	-	-	3	3	1.5	40	60	100	03
8	24HU411	Universal Human Values (UHV) - II	HSMC	IP	HU	2	-	-	2	2	20	30	50	02
		NSS/NCC/SDA/SPORTS/YOGA	SDA							-	-	-	-	-
Total										**24.5**	**300**	**450/510***	**750/810***	

***For lateral entry students**

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(Effective from the academic year 2024-25)

SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER: V

Sl. No	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1.	24IP510	Management & Entrepreneurship	PCC	IP	IP	3	-	-	3	3	40	60	100	03
2.	24IP520	Design of Machine Elements	PCC	IP	IP	2	1	-	3	3	40	60	100	03
3.	24IP530	Product Design & Product Life Cycle Management	PCC	IP	IP	2	1	-	3	3	40	60	100	03
4.	24IP540	Industrial Engineering & Ergonomics	PCC	IP	IP	3	-	2	5	4	40	60	100	03
5.	24IP55x	Professional Elective-I	PEC	IP	IP	3	-	-	3	3	40	60	100	03
6.	24IP56x	Professional Elective-II	PEC	IP	IP	3	-	-	3	3	40	60	100	03
7.	24IP57xOE	Open Elective-II	OEC	IP	IP	3	-	-	3	3	40	60	100	03
8.	24IP58L	Computer Aided Engineering Analysis Lab	PCCL	IP	IP	-	-	3	3	1.5	40	60	100	03
9	24HU510	Constitution of India & Professional Ethics	HSMC	HU	HU	2	-	-	2	-	40	-	40	-
		NSS/NCC/SDA/SPORTS/YOGA	SDA							-	-	-	-	-
Total										**23.5**	**360**	**480**	**840**	

Professional Elective-I		Professional Elective-II	
24IP551	Theory of Metal Forming	24IP561	Engineering Economics
24IP552	Non-Destructive Testing	24IP562	Marketing Management
24IP553	Hydraulics & Pneumatics	24IP563	Six Sigma Methodology
24IP554	Tool Engineering Design And Fixtures	24IP564	Statistics For Engineers

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER:VI

Sl. No	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1.	24IP610	Operations Research	PCC	IP	IP	3	-	2	5	4	40	60	100	03
2.	24IP620	Computer Aided Design and Manufacturing	PCC	IP	IP	2	1	-	3	3	40	60	100	03
3.	24IP630	Quality Engineering	PCC	IP	IP	3	-	-	3	3	40	60	100	03
4.	24IP640	Lean Manufacturing	PCC	IP	IP	3	-	-	3	3	40	60	100	03
5.	24IP65x	Professional Elective-III	PEC	IP	IP	3	-	-	3	3	40	60	100	03
6.	24IP66x	Professional Elective-IV	PEC	IP	IP	3	-	-	3	3	40	60	100	03
7.	24IP67xOE	Open Elective-III	OEC	IP	IP	3	-	-	3	3	40	60	100	03
8.	24IP68L	Computer Aided Manufacturing Lab	PCCL	IP	IP	-	-	3	3	1.5	40	60	100	03
		NSS/NCC/SDA/SPORTS/YOGA	SDA											
Total										**23.5**	**320**	**480**	**800**	

Professional Elective-III		Professional Elective-IV	
24IP651	Composite Materials	24IP661	Data Base Management System
24IP652	Non Traditional Machining	24IP662	Project Management
24IP653	World Class Manufacturing	24IP663	Total Quality Management
24IP654	Value Engineering	24IP664	Organizational Behavior

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER: VII

Sl. No	Course code	Course Title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1	24IP710	Supply Chain Management	PCC	IP	IP	3	-	-	3	3	40	60	100	03
2	24IP72x	Professional Elective-V	PEC	IP	IP	3	-	-	3	3	40	60	100	03
3	24IP73x	Professional Elective-VI	PEC	IP	IP	3	-	-	3	3	40	60	100	03
4	24IP74P	Industrial training /Internship	PWC	IP	IP	-	-	2	2	2	40	--	40	--
5	24IP75P	Project Work Phase-I	PWC	IP	IP	-	-	2	2	2	40	--	40	--
Total										13	200	180	380	

Professional Elective-V		Professional Elective-VI	
24IP721	Facilities Planning & Design	24IP731	Maintenance Engineering & Industrial Safety
24IP722	Industry 4.0	24IP732	Energy Audit
24IP723	Industrial Robotics	24IP733	Engineering Systems Design
24IP724	Data Analytics for Engineers	24IP734	Management Information Systems
24IP72S	Swayam/NPTEL Course	24IP73S	Swayam/NPTEL Course

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

SEMESTER: VIII

Sl. No	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam Duration in hours
						L	T	P	TOTAL		CIE	SEE	Total	
1	24IP81x	Professional Elective-VII	PEC	IP	IP	3	-	-	3	3	40	60	100	03
2	24IP82P	Project work Phase-II	PWC	IP	IP	-	-	10	10	10	40	60	100	03
Total										13	80	120	200	

Professional Elective-VII	
24IP811	Operation Management
24IP812	Human Resource Management
24IP813	Additive Manufacturing
24IP81S	Swayam/NPTEL Course

Note: A student can get exemption from professional elective course(s) (up to 2), either in 7th or 8th semesters if he/she opts to consider duly completed SWAYAM/NPTEL course(s). To qualify as a 3-credit course, the SWAYAM/NPTEL course must be of at least 12 weeks long (one course of 12 weeks, two courses of 8 weeks and 4 weeks, or three courses of 4, 4, and 4 weeks or any other combination). Enrolling in the SWAYAM/NPTEL course is mandatory. However, opting for exemption from professional elective course is at the discretion of the student.

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Open Elective- I	
24IP451OE	Computer Aided Design
24IP452OE	Non-Destructive Testing
24IP453OE	Composite Materials

Open Elective-II	
24IP571OE	Lean Practices
24IP572OE	Maintenance Engineering & Industrial Safety
24IP573OE	Energy Engineering & Management
24IP574OE	Engineering Economics

Open Elective-III	
24IP671OE	Organizational Behavior
24IP672OE	World Class Manufacturing
24IP673OE	Additive Manufacturing
24IP674OE	Marketing Management

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SCHEME OF TEACHING AND ASSESSMENT FOR B.E -Industrial & Production Engineering

Category Code:
BSC–Basic Science Course
ESC–Engineering Science Course
PCC – Professional Core Course (Including Laboratory subjects)
PEC-Professional Elective Course
OEC-Open Elective Course
HSMC – Humanities Social Science and
Management Course PWC–Project
Work Course
List of SWAYAM Courses identified by the department (for Professional Elective –IV):
(Students can complete 12 Weeks of SWAYAM course/s between 3-6th Semester to claim exemption for Elective-IV)

Sl. No.	SWAYAM Course Title	No of Weeks
1.	Communication Skills	12Weeks
2.	Business Research Methods	12Weeks
3.	Consumer Behavior	12Weeks
4.	Computer Application in Business	12Weeks
5.	Organizing and Managing Information	12Weeks
6.	Sustain ability Science	12Weeks
7	Advanced Materials & Processes	12Weeks
8	Microprocessor and Mechatronics in Swayam	12Weeks
9	Advanced Machining Processes	8Weeks
10	Advances in welding & Joining Technology	8Weeks
11	Condition Monitoring and Maintenance Management	8Weeks
12	Intellectual Property Rights	8Weeks
13	Design Thinking and Primer	4Weeks
14	Documents Processing and Organizations	4Weeks

III Semester

(Non-Credit Course)

(For Lateral Entry Students)

<table>
<tr><td>DEPARTMENT</td><td colspan="7">Mathematics</td></tr>
<tr><td>Course Code</td><td colspan="2">24MATDIP310</td><td>Total Credits</td><td>00</td><td>Course Type</td><td colspan="2">Theory-Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="7">Foundations of Engineering Mathematics-I (For III Semester Lateral Entry Students)</td></tr>
<tr><td rowspan="5">Teaching Learning Process</td><td></td><td>Contact Hours</td><td>Credits</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>03</td><td>00</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>00</td><td>00</td><td>Weightage</td><td>--</td><td>100%</td><td>100%</td></tr>
<tr><td>Practical</td><td>--</td><td>--</td><td>Maximum Marks</td><td>--</td><td>60</td><td>60 Marks</td></tr>
<tr><td>Total</td><td>03</td><td>00</td><td>Minimum Marks</td><td>--</td><td>24</td><td>24 Marks</td></tr>
</table>

Pre requisites: Basics in Differential calculus, Integral calculus and Vectors.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve.	L2
CO2	Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions.	L2
CO3	Understand how a function of single variable can be expanded as a Taylor's series and handle the indeterminate form.	L2
CO4	Illustrate the applications of multivariate calculus to understand the characteristics of vector field.	L2
CO5	Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Syllabus:

UNIT No.	Content	Lecture Hours
UNIT 1	**Differential Calculus-I:** Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)	8
UNIT 2	**Differential Calculus–II:** Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.	8
UNIT 3	**Differential Calculus–III:** Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms, L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$)	8
UNIT 4	**Vector Calculus:** Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.	7
UNIT 5	**Differential Equations-I:** Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.	8

Text Books:

Sl. No	Author/s	Title	Publisher Details
1	B.S. Grewal	Higher Engineering Mathematics	44th Edition, 2015, Khanna Publishers, ISBN: 978- 81-933284-9-1.
2	E. Kreyszig	Advanced Engineering Mathematics	10th Edition (Reprint), 2016, John Wiley & Sons, ISBN: 978-0470458365
3	M.K. Jain, S.R.K. Iyenger and R.K. Jain	Numerical methods for scientific and engineering computation	6th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235

Reference Books:

Sl.No.	Author/s	Title	Publisher Details
1	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics	Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019, ISBN: 9789352743766, 9789352743766.
2	Maurice D. Weir, Joel R. Hass and George B. Thomas,	Thomas' calculus: Early Transcendentals	12th edition, Pearson Education, 2016. ISBN: 978-07802-426-9.
3	B. V. Ramana	Higher Engineering Mathematics	11th edition, Tata-McGraw Hill, 2010, ISBN:0-07-053516-7.
4	Peter V.O 'Neil	Advanced Engineering Mathematics	7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012, ISBN: 978- 81-315-0310-2.

Web/Digital resources:

Sl.No.	Web Link
1	https://www.classcentral.com/subject/maths
2	https://academicearth.org/

Course Articulation Matrix:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3										
CO3	3										
CO4	3										
CO5	3										

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

THIRD SEMESTER						
Course Code: 24MA311	Engineering Mathematics-III (Common to CV, MECH, IP, ENV, CTM, BT and PST)					
Total Credits: 03 *L-45: T-0: P-0: SL and TW-45*	*SDGs addressed: 4, 5, 9, 16, 17*		*Course Category: Basic Science Course*	*Course Type: Theory*		
Teaching Learning Process		*Total Contact Hours/semester*	*Assessment Weightage and Marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	*40*	*60*	*100*
	Practical	-	*MaximumMarks*	*40*	*60*	*100*
	Self-learning and Teamwork	45	*MinimumMarks*	*20*	*25*	*45**
	Total	90				

Note: *For passing the student must score a Minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Course Pre-Requisite: Engineering Mathematics I and II

Course objective: This course will enable students to:

1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave and heat equations.
4. To make the student to solve system of linear equations, carryout matrix operations, determine the eigenvalues & eigenvectors.
5. To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function.

Course Outcomes (CO's): After the completion of this course, students will be able to:

CO	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Apply basic mathematical operations on complex numbers in artesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function.	L2	WK1, WK3
CO2	Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues.	L3	WK2, WK6
CO3	Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations.	L3	WK1, WK4
CO4	Test the system of linear equations for consistency, Linear Independence and Dependence. Determine and describe the characteristic equation, Eigen vectors and Diagonalization.	L3	WK4, WK8
CO5	Compute extreme values of a variational problems like geodesics, least time and shortest path.	L3	WK2, WK8

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Syllabus:

Unit No.	Content	Lecture Hours
1	**Complex Variables**: Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only), Construction of Analytic functions, Harmonic Conjugates. **Self-Learning and Teamwork** • Recapitulation of Basic Concepts • Discuss some application aspects based on properties of analytic functions- Stream lines and Complex potential	**09**
2	**Complex Integration:** Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues. **Self-Learning and Teamwork** • Evaluation of the line integral over the region C: straight line • Proof of Cauchy's integral formula • Calculation of residues of order four	**09**
3	**Partial differential equations (P.D.E.):** Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. Applications of P.D.E.: Classification of PDE, solution of one dimensional heat and wave by the method of separation of variables. **Self-Learning and Teamwork** • Form Partial differential equation by eliminating arbitrary constants • Derive one dimensional wave equation • Innovative applications of heat equation	**09**
4	**Linear Algebra:** System of linear equations, Row operations, Echelon form Reduced Echelon form, Solution of Homogeneous and Nonhomogeneous equations, vector equations, Linear combinations, Linear independent/dependent vectors, Eigen values, Eigen vectors, Diagonalizations. **Self-Learning and Teamwork** • Column operation • To fine rank of a matrix by reducing to the normal form • Basic definitions of Homogeneous and Nonhomogeneous equation	**09**
5	**Calculus of Variation**: Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution and hanging chain. **Self-Learning and Teamwork** • Discuss Maxima and minima for a function of two variables • Surfaces of least area enclosed by a given boundary	**09**

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, 2015, Khanna Publishers.
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition (Reprint), 2016, John Wiley & Sons.
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical methods for scientific and engineering computation, 6th Edition, 2012, New Age International Publishers.

Reference Books:

1. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019.
2. Maurice D. Weir, Joel R. Hass and George B. Thomas, Thomas' calculus: Early Transcendental, 12thedition, Pearson Education, 2016.
3. B. V. Ramana, Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill, 2010.
4. Peter V.O 'Neil, Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

Web/Digital resources:

1. https://www.classcentral.com/subject/maths
2. https://academicearth.org/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3	1										
CO4	3	1										
CO5	3	1										

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

PO2: ability to analyze engineering problems

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP310</td><td colspan="5">Course Title: Industrial Metrology</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T- : P-15 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>15</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

Course objectives: The main objective of this course is to make students familiar with the measuring systems and standards of measurements, use of metrological instruments and gauges. It further aims to make them understand the basic measurement systems in the real time engineering applications.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the basics concepts of measurements, metrology and measuring devices and apply the transducer concept of measurements.	L1, L2	WK1 to WK4
CO2	Illustrate the basic concepts of limits, fits, tolerance and guaging with the help of numerical problems.	L1, L2, L3	WK1 to WK6
CO3	Explain the basic concepts of comparator application from the industrial perspective.	L1, L2, L3	WK1 to WK6
CO4	Explain the basic concepts of screw threads and Gear measurements with the mathematical approaches, temperature and strain measurements with the industrial applications.	L1, L2, L3	WK1 to WK6
CO5	To understand the working principle of measuring instruments like profile projector, tool maker's microscope, floating carriage micrometer, comparators, To demonstrate the working principle of profile projector, tool maker's microscope, floating carriage micrometer, comparators	L1, L2	WK1 TO WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Standards of measurement:** Definition, Significance of measurement, fundamental methods of measurements, generalized measurement system, basic definitions and concept of accuracy, precision, errors in measurement, classification of errors. **Transducers**: Transfer efficiency, Primary and secondary transducers, Mechanical transducer, Electrical transducer –Resistive transducer, Inductance transducer, capacitive transducer, Electronic transducer. *Self-Learning and Teamwork:* • Importance of measurement for industries • Application of transducers	09	--
2	**System of Limits, Fits, Tolerances:** Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, concept of limits of size and tolerances, definition of fits, types of fits and their designation, Geometrical tolerance, positional tolerances, Hole basis and shaft Basis of system. Problems. **Classification of gauges:** Brief concept of design of gauges, (Taylor's Principles), Wear allowance on gauges, Types of gauges - Plain plug gauge, ring gauge, snap gauge, limit gauge. Problems *Self-Learning and Teamwork:* • Gauge materials • Importance of interchangeability for industries.	09	--
3	**Introduction to Comparator:** Characteristics, classification of comparators – Mechanical comparators - Johnson Mikrokator, Sigma Comparators, dial indicator, Optical Comparators - Principles, Zeiss ultra optimeter, Linear Variable Differential Transformer (LVDT)., Pneumatic Comparators, Back pressure gauges, Solex Comparators. *Self-Learning and Teamwork:* • *Industrial applications of* different types of Comparators.	09	--
4	**Screw thread and Gear measurement:** Terminology of screw threads, Measurement of major diameter, minor diameter, effective diameter of screw threads by 2-wire methods, best size wire. **Gear measurement:** Gear terminology, Gear measurement, checking of composite error, measurement of Individual elements of gear, Gear tooth vernier caliper. *Self-Learning and Teamwork:* • Practical applications of Gear tooth measurement.	09	--
5	**Temperature Measurement:** Introduction, Thermoresistive elements, Thermoelectric effects, Thermocouples-laws of thermocouples, Total radiation Pyrometers, Optical Pyrometers. **Strain Measurement:** Mechanical Strain gauges – Berry Extensometer, Optical Strain gauge – Tuckerman Optical Extensometer, preparation and mounting of strain gauges, Problems Associated with Strain Guage Installation, Requirements for Accurate strain measurement and applications of strain gauges. *Self-Learning and Teamwork:* • Applications of Thermocouples in industries. • Applications of Mechanical and Optical Strain gauges.	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMEN not for SEE –SEMESTER END EXAMS

Course Content / Syllabus(Laboratory)

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	Usage of Micrometer, Vernier calipers & depth gauge for measurement of basic components. Demonstration of height gauge.	-	-	2
2	Measurements of thread parameters and measurement of flat surfaces and radius of curvature using Optical Projector / Toolmaker Microscope	-	-	3
3	Setting of angles using Sine Center / Sine bar / bevel protractor, slip gauges and Measurement of taper angles using bevel protractor, sine centre and standards	-	-	3
4	Measurements of Screw thread Parameters using floating carriage micrometer (using two wire method)	-	-	3
5	Measurements of gear tooth profile using gear tooth vernier /gear tooth micrometer.	-	-	2
6	Calibration of micrometer using slip gauges, Dial gauge	-	-	2

Text Books:

1. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education,6th Ed., 2006.
2. Engineering Metrology, R.K. Jain, Khanna Publishers,1994.

Reference Books:

1. Engineering Metrology & Measurements: Dr. N.V. Raghavendra& Dr.L. Krishnamurthy

2. Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications, Delhi.

3. Mechanical Measurements, R.K. Jain Khanna Publishers,1994

4. Industrial Instrumentation, Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd.2002.

5. Measurement Systems Applications and Design, Ernest O.Doebelin, 5th Ed., McGrawHill BookCo.

6. Metrology & Measurement, Anand K. Bewoor& Vinay A. Kulkarni, Tata McGrawHill Pvt. Ltd., New- Delhi

Web/Digital resources:

1. https://nptel.ac.in/courses/112/106/112106179/
2. https://nptel.ac.in/courses/112/104/112104250/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	1		3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3	1		3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

INTEGRATED LAB -24IP310

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	3
CO2	3	3	3		3	3					3	3	2	3
CO3	3	3	3		3	3					3	3	2	3
CO4	3	3	3		3	3					3	3	2	3
CO5	3	3	3		3	3					3	3	2	3

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP320</td><td colspan="5">Course Title: Theory of Machines</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T- 15: P-0 : SL and TW-60</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>15</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: ENGINEERING MECHANICS

Course Objective:

- To understand the concepts of Kinematic Link , gears, cams and followers, flywheel, belt drives.
- To understand Turning Moment diagrams for 4-stroke single-cylinder & Multi-Cylinder Engines To differentiate between static loading and dynamic loading.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Understand and Explain the Basic terminology of Mechanism, Slider Crank mechanism, Quick return Motion mechanisms, Straight line mechanisms.	L2	WK1 to WK4
CO2	Analyze the types of gear trains, find the velocity ratio and torque for different gear train systems.	L4	WK1 to WK6
CO3	Analyze & construct the profile of CAMS for different motions of followers like Uniform Velocity, SHM , UARM.	L4	WK1 to WK6
CO4	Analyze the Turning Moment diagrams for 4-stroke single-cylinder & Multi Cylinder Engines and power transmission for belt drives.	L4	WK1 to WK6
CO5	Analyze the static force vector diagram for four Bar Mechanism, slider Crank Mechanism and balancing of rotating masses in single plane and different Planes.	L4	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Definitions: kinematic link, kinematic pairs, kinematic chain, machine, Mechanism, inversion, degrees of freedom, Grubler's criterion. Inversions of four bar chains- single slider crank chains and double slider crank chains. Mechanisms with lower pairs: Straight line motion mechanisms, pantograph, Toggle mechanism, Ackerman steering gear mechanism, intermittent motion mechanisms- Geneva mechanisms, Self-Learning and Team Work: • Ratchet and pawl mechanism.	**9**	**3**
2	**Gears and Gear trains:** Classification & application of different types of gears, Spur Gear terminology, Simple gear trains, Compound gear trains, Reverted gear trains, Tabular method of finding velocity ratio of epicyclic gear trains. Estimation of Tooth load and torque in epicyclic gear trains. Self-Learning and Team Work: • Applications of Epicyclic gear trains	**9**	**3**
3	**Cams:** Definition, types of followers, types of Cams, Cam terminology, Disc cam with reciprocating follower having knife edge, roller edge, spherical faced and flat faced followers, disc cam with oscillating roller follower. Displacement, velocity and acceleration diagrams for follower motions like Uniform velocity, **Self-Learning and Team Work:** • Applications of Simple Harmonic Motion, uniform acceleration & retardation and cycloidal motion.	**9**	**3**
4	Turning moment diagrams and flywheel : Introduction , turning moment diagram (TMD) for single cylinder double acting steam engine, TMD for 4 Stroke or IC engine , TMD for multi cylinder engine, types of flywheel, Numerical Problems. Belt Drives: Flat belt drives, velocity ratio, initial tension, ratio of belt tensions, Self-Learning and Team Work: • Applications of effect of centrifugal tension, transmission of power, maximum power condition.	**9**	**3**
5	Static Force Analysis: Introduction, Reaction between members, Constrained and applied forced Equilibrium of two force and three force members force analysis of four bar mechanism and engine mechanism. Balancing of Machinery: Static and Dynamic balancing, balancing of single rotating masses in same plane and in different planes, balancing of several rotating masses in same and different planes Self-Learning and Team Work: • Applications of Static and Dynamic balancing	**9**	**3**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs] is only considered for CIE – INTERNAL ASSESSMEN not for SEE –SEMESTER END EXAMS

Text Books:

1. J.K. Gupta and R.S. Khurmi, "Theory of Machines" –14th Edition, 2020
2. Rattan S.S, "Theory of machines", Tata McGraw Hill Publishing company Ltd., 5th Edition, 2019.

Reference Books:

1. A Sadhu Singh , " Theory of Machines", Pearson Edition 2002
2. Thomas Bevan , "Theory of Machines", CBS Publications 3rd edition, 2009
3. Prof. P.L.Ballaney, "Theory of Machines and Mechanisms",Khanna Publications 2003. 4. Ghosh & Mallik, "Theory of Machines and Mechanism", East Publications, 2008

Web/Digital resources:

1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/105/112105268/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	2		3	3						3	2	1
CO3	3	3	2		3	3						3	2	1
CO4	3	3	2		3	3						3	2	1
CO5	3	3	2		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP330</td><td colspan="4">Course Title: Fluid Mechanics</td></tr>
<tr><td colspan="3">Total Credits: 04
L- 45: T- 15: P-0 : SL and TW-60</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>15</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre requisites: NIL

This course will enable students to:

Course Objective: The course objective is to make students understand the basic principles, fundamental concepts in fluids mechanics and kinematics so as to prepare them for an advanced course on Hydraulics.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working knowledge
CO1	Describe the properties of fluids and fluid statics	L1, L2	WK1 to WK4
CO2	Explain fluid kinematics fluid kinematics and Dimensional analysis	L1, L2	WK1 to WK4
CO3	Apply fundamental concepts to study Fluid Dynamics and its Flow Measurements	L1, L2, L3	WK1 to WK6
CO4	Illustrate different methods of Laminar and Viscous flow effects	L1, L2,	WK1 to WK4
CO5	Apply fundamental concepts to study different flow past immersed bodies	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content /Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Properties of Fluids: Introduction, of Fluids, Viscosity, Thermo dynamic properties, Surface tension and Capillarity, Vapour pressure & Cavitations. Fluid Statics: Fluid pressure at a point, Pascal's Law, Pressure variation in a static fluid, Absolute , Gauge, Atmospheric and Vacuum Pressures, Simple manometers, Differential Manometers, Total pressure and Center of Pressure, Vertical Plane, Horizontal plane, Inclined, Curved Surface submerged in liquid, Buoyancy, Centre of buoyancy, meta center and meta centric height, Conditions of equilibrium of floating and submerged bodies *Self learning and Team Work:* • Applications of Buoyancy in industry	3 6	3
2	Fluid Kinematics: Types of Fluid flow, Introduction, Continuity equation, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function Dimensional Analysis: Introduction, Derived quantities, dimensions of physical quantities, dimensional homogeneity (No Derivation) *Self learning and Team Work:* • Study on fluid flow, continuity equations in 3D • Physical quantities (Dimensional analysis)	6 3	3
3	Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation, Euler's equation, Bernoulli's equation for real fluids. Fluid Flow measurements: Introduction, Venturimeter, orifice meter, pitot tube. Flow through pipes - Frictional loss in pipe flow, Darcy- Equation for loss of head due to friction in pipes, Chezy'sequation for loss of head due to friction in pipes, hydraulic gradient and total energy line. *Self learning and Team Work:* • Application of Bernoulli's equation for real fluids	4 5	3
4	Laminar and Viscous Flow effects: Reynolds's number, critical Reynolds's number, Laminar flow through circular pipe-Laminar Flow between parallel and stationery plates. *Self learning and Team Work:* • Application of Reynold number	9	3
5	Flow past immersed bodies: Drag Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, displacement thickness, momentum thickness and energy thickness. Introduction to Compressible flow: Velocity of sound in a fluid, Mach number *Self learning and Team Work:* • Application of Drag, Lift, Pressure drag, friction drag in aero industry	9	3

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs] is only considered for CIE – INTERNAL ASSESSMEN not for SEE –SEMESTER END EXAMS

TEXTBOOKS:

1. Fluid Mechanics - Dr.BanssalR.K , Lakshmi Publications,2004.
2. Fluid Mechanics and Hydraulics - Dr.Jagadishlal , Metropolitan Book Co. Ltd.,1997.

REFERENCEBOOKS:

1. Fluid Mechanics-Yunus A .Cingel john M.Oimbala, TATA McGraw hill Publications 2006
2. Fluid Mechanics - Oijshush K. Kundu, Iram Cochin, El Sevier 3rd Edition2005. 3. Fluid Mechanics –Govind Rao , IISC,Bangalore

Web/Digital resources:

1. https://nptel.ac.in/courses/112/105/112105269/
2. https://nptel.ac.in/courses/112/105/112105183/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP340		*Course Title: Metal Cutting & Machine Tools*				
Total Credits: 03 L- 45: T- 0: P-0 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PCC*	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	*40*	*60*	*100*
	Practical	-	*Maximum Marks*	*40*	*60*	*100*
	Self-Learning and Teamwork	45	*Minimum Marks*	*20*	*25*	*45**
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Elements of mechanical Engineering.

COURSE OBJECTIVES: This course will enable students to:

1. To introduce the concept of different types of cutting tools & machining parameters
2. To introduce the concept of tool wear & tool life
3. To introduce the concept of MCD & its importance
4. To make the student to known different types machine tools 5. To find the tool life by Tylor's tool life equation

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working knowledge
CO1	Recognize various metal cutting operations with machining parameters	L2	WK1 to WK4
CO2	Illustrate tool life with tool wear concepts and cutting fluids	L2	WK1 to WK4
CO3	Illustrate the lathe types with different operations. Importance of drilling, shaping and planning machine	L3	WK1, WK4 & WK6
CO4	Explain the grinding machine and its operations	L3	WK1, WK4 & WK6
CO5	Expound the importance of milling machine	L3	WK1, WK4 & WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Theory of Metal Cutting:** Single point cutting tool nomenclature, geometry, Identification of tool inserts and tool holders Characteristics graphs on the effects of cutting conditions on Metal Removal Rate (MRR), orthogonal and oblique cutting, Mechanism of chip formation, types of chips, Merchant circle diagram, shear angle relationship, Problems *Self learning and Team Work:* • Tool nomenclature, Geometry • Mechanism of chip formation	9	
2	**Tool Life & Tool wear:** Types & Forms of Tool Wear and tool failure & effects of cutting parameters, Tool life criteria, Taylor's tool life equation, and problems on tool life, Cutting Fluids: Types & properties of cutting fluids and selection., characteristic graphs of the effects of cutting fluids on Metal Removal Rate (MRR). *Self learning and Team Work:* • Types & Forms of Tool Wear • Taylor's tool life equation	9	
3	**Turning Machines**: Introduction, types of lathes –Capstan & Turret Lathes, constructional features, operations, different methods of taper turning, gear combination calculations for thread cutting, work holding & tool holding devices **Drilling Machines:** Classification, constructional features, Radial and Pillar drilling machines, operations of drilling machines with counter sinking and counter boring operations, nomenclature of a twist drill bit *Self learning and Team Work:* • Turning Machines (types of lathes- NC and CNC) • Operations of drilling machines	9	
4	**Shaping and Broaching Machines**: Construction features, and operations of Shaping machine & broaching machines for internal and External broach **Milling Machines**: Classification, constructional features,& milling cutters nomenclatures, Milling operations, up milling and down milling concepts and its Applications *Self learning and Team Work:* • Shaping and Broaching Machines	9	
5	**Grinding Machines**: Classification, constructional features, Specification of Grinding wheel, Selection of Grinding wheels,Types of Abrasives, bonding process, Centerless Grinding Machines & its applications **Super finishing process:** Honing, lapping and super finishing *Self learning and Team Work:* □ Grinding Machines • Super finishing process	9	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMEN not for SEE –SEMESTER END EXAMS

TEXT BOOKS:

1. **Production Technology**: HMT – Tata McGraw Hill
2. **Production Technology**: R.K.Jain, Khanna Publications

REFERENCE BOOKS:

1. **Manufacturing Science**: Amitabha Ghosh and Mallik, Affiliated East Westpress,
2. **Metal cutting principles:** M.C. Shaw, MIT press Cambridge, Massachusetts,1996.
3. **Manufacturing Technology:** Vol.-I, P. Radha Krishnan, Sceitch Publications,Chennai
4. **Manufacturing Process and materials of manufacture**: Roy A. Lindberg Prentice Hall ofIndia,
5. **Fundamentals of metal machining and machine tools:** G. Boothroyd, McGrawHill 6. **Metal cutting and tool design**: Dr. B.J. Ranganath VikasPublications.

Web/Digital resources:

1. https://nptel.ac.in/courses/112/105/112105233/
2. https://nptel.ac.in/courses/112/105/112105306/

Course Articulation:

POs → **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			3	3					1	2	1	1
CO2	3	3			3	3					1	2	1	1
CO3	3	3	1		3	3					1	2	1	1
CO4	3	3	1		3	3					1	2	1	1
CO5	3	3	1		3	3					1	2	1	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP350D		*Course Title: Computer Aided Machine Drawing*				
Total Credits: 04 L- 15: T- : P-30 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PCC*	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	15		CIE	SEE	Total
	Tutorial	-	*Weightage %*	*40*	*60*	*100*
	Practical	30	*Maximum Marks*	*40*	*60*	*100*
	Self-Learning and Teamwork	45	*Minimum Marks*	*20*	*25*	*45**
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

PRE REQUISITES: Computer Aided Engineering Graphics.

COURSE OBJECTIVES: This course will enable students to:

To impress the student about drawing practices & to learn the methods of drawing using Solid Edge/Solid Works software. The students learn not only the fundamentals of Machine Drawing but also the practically learn the methods using the modeling software.

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet, Sheet sizes, Naming a drawing, Drawing units, grid and snap.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working knowledge
CO1	To create the isometric Solid 3D component and convert 3 Dimensional views to 2 Dimensional views [Front view, top view, Profile View]	L3,L6	WK1 to WK6
CO2	To create 2- Dimensional ISO standard Thread forms with all relevant dimensions, Thread Terminology	L3, L6	WK1 to WK6
CO3	To Create 2Dimensional Riveted joints	L3, L6	WK1 to WK6
CO4	To Create 2Dimensional Joints and Coupling Components and create the assembly	L3, L6	WK1 to WK6
CO5	To Create 3- Dimensional Solid parts of particular assembly and assembling the parts	L3, L6	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT	Content	Hours		
No.		**Lecture**	**Tutorial**	**Practical**
1	**Orthographic Views**: Conversion of pictorial views into orthographic projections of simple machine parts with or without section – 4 Examples. **Thread forms**: Thread terminology, Sectional views of threads, ISO Metric (Internal & External), BSW (Internal & External), Square and Acme, Sellers thread, American Standard thread, Basic Knuckle Thread. *Self learning and Team Work:* *Practice session – Orthographic views, thread forms*	2 1	-	03
2	**Fasteners**: Hexagonal Headed bolt and nut with washer (assembly), Square Headed bolt and nut with washer (assembly) Only for practice not for Exam) **Keys**: Parallel key, Taper key, Feather key, Gib head key and Wood ruff key (Only for practice not for Exam). *Self learning and Team Work:* Practice session – Fasteners and Keys	3	-	02
3	**Riveted Joints**: Snap Head Rivet for Practice, Single and double riveted lap joints, Butt joints with single/double cover straps, Chain and Zigzag, using snap head rivets. *Self learning and Team Work:* Practice session – Riveted joints	2	-	03
4	**JOINTS AND COUPLINGS**: Cotter joint, Socket joint and Spigot joint, Knuckle joint **COUPLINGS**: Solid Muff coupling, Un-Protected type flanged coupling, Protected type flexible coupling. *Self learning and Team Work:* Practice session – Joints and Couplings	2	-	02
5	**Assembly Drawings** (Part drawings should be given): Screw jack (Bottle type), Plummer block (Pedestal Bearing), Machine vice, Tailstock of lathe (Only for practice not for Exam), Tool Head of a shaper (Only for practice not for Exam) *Self learning and Team Work:* Practice session – Assembly of Screw jack (Bottle type), Plummer block (Pedestal Bearing), Machine vice	5	-	20

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT and ALSO for SEE –SEMESTER END EXAMS are [ORTHOGRAPHIC VIEWS -3D CONVERSION 3D TO 2D, Screw threads, Riveted joints , Joints and Couplings , Assembly drawings –Screw Jack, Plummer block, Machine Vice)

TEXT BOOKS :

1. 'Machine Drawing' , K.R. Gopala Krishna, Subhash Publication

2. 'Machine Drawing', N.D.Bhat &V.M.Panchal

3. 'A Primer on Computer Aided Machine Drawing', Published by VTU,Belgaum.

Web sources/ digital website

1. https://scholar.cu.edu.eg/?q=mohamedabdou/files/01_introduction_5.pdf
2. www.learnvern.com › catia-course › steam-engine-genera

****Equivalent subject Codes : IP350L/20IP350D/22IP350D/24IP350D

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2	PSO3
CO1	3	3	3		3	3					3	3	3	3
CO2	3	3	3		3	3					3	3	3	3
CO3	3	3	3		3	3					3	3	3	3
CO4	3	3	3		3	3					3	3	3	3
CO5	3	3	3		3	3					3	3	3	3

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP36L</td><td colspan="5">Course Title: Metal Cutting & Machine Tools Lab</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 0: T- 0: P-45 : SL and TW-0</td><td colspan="3">SDGs addressed: 4, 9 & 12</td><td>Course Category: PCCL</td><td>Course Type: Laboratory</td></tr>
<tr><td rowspan="2">Teaching Learning Process</td><td></td><td>Total Contact hours/Semeste</td><td colspan="4">Assessment in Weightage and marks r</td></tr>
<tr><td>Lecture</td><td>-</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td rowspan="4"></td><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>45</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>-</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>45</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Understanding the basic tools used for different operations, safety regulations & layout of the laboratory	L2	WK1 to WK6
CO2	Demonstrate the various Operations in lathe involving plain, taper and step turning, thread cutting, eccentric turning. understand the acceptance criteria of lathe, shaping machine, milling machine	L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	Understanding the basic tools used for different operations, safety regulations & layout of the laboratory	-	-	06
2	Preparation of the Models using different Machine tools Practice session on: machine operations- involving plain, taper and step turning, thread cutting, eccentric turning. understand the acceptance criteria of lathe, shaping machine, milling machine	-	-	39

Text Books:

1.Manufacturing process –II by

2.Radhakrishna Production technology by HMT.

Course Articulation: CO – PO MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2	PSO3
CO1	3	3	3		3	3					3	3	3	3
CO2	3	3	3		3	3					3	3	3	3
CO3	3	3	3		3	3					3	3	3	3
CO4	3	3	3		3	3					3	3	3	3
CO5	3	3	3		3	3					3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT OF HUMANITIES SCHEME & SYLLABUS

Third/Forth Semester

(From the Academic Year 2024-25)

<table>
<tr><td colspan="7">Department: Environmental Engineering</td></tr>
<tr><td colspan="2">Course Code: 24HU312-24HU412</td><td colspan="5">Course Title: Environmental Studies</td></tr>
<tr><td colspan="2">Total Credits: 2
L-30; T-0; P-0; SL&TW: 30</td><td colspan="2">SDGs addressed: 3, 6, 7, 9, 11, 12, 13, 14, 15</td><td colspan="2">Course Category: HSMC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Contact Hours/Semester</td><td colspan="5">Assessment Weightage and Marks</td></tr>
<tr><td>Lecture</td><td>30</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage, %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td rowspan="2">Maximum Marks</td><td rowspan="2">20</td><td rowspan="2">30</td><td rowspan="2">50</td></tr>
<tr><td>Self-learning & Term work</td><td>30</td></tr>
<tr><td>Total</td><td>60</td><td>Minimum Marks</td><td>10</td><td>13</td><td>23*</td></tr>
</table>

***Note:** For passing, the student has to score a minimum of 23 marks (CIE + SEE = 10+13 or 11 +12).

Course Pre-Requisite: NIL

Course Objective: The student gains knowledge on basic concepts on Environmental aspects and understands its importance in various disciplines for safeguarding the environment.

Course Outcomes (COs)

CO	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water attributes at regional and global scales.	L2	1, 3, 7
CO2	Develop critical thinking/observation skills - apply them to identify and analyze environmental issues.	L2	2, 3
CO3	Understand the complex ecological relationship between biotic and abiotic components.	L2	1, 4
CO4	Apply ecological knowledge to illustrate and address environmental problems for better management.	L2	3, 4, 5, 6, 7, 8
CO5	Understand the recent technologies and legal aspects	L2	5, 7, 8, 9

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Syllabus:

UNIT No.	Content	Lecture Hours
1	Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Ecological principles, Difference between Ecology, Environment, and Ecosystem, Different types of energy - Conventional sources & Non-Conventional sources of energy Solar energy, Hydroelectric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as alternative energy. ***Self-Learning and Termwork:*** • Ecological Pyramids • Generations of biofuels • Bio-geochemical cycles.	**7**
2	Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources. Climate change - Global Warming, Acid rain, urban Heat Island & Ozone layer depletion, controlling measures. Deforestation – Causes, Implication for climate change, Economical Impacts, Strategies for reducing deforestation. Impacts of Agriculture – Pollution due to the use of chemical fertilizer, soil-related effects, and Emission of methane with relevant case studies. ***Self-Learning and Termwork:*** • Positive feedback loop • Montreal Protocol • Kyoto Protocol	**7**
3	Environmental Pollution – Air Pollution, Water Pollution, Noise Pollution, Land Pollution, Public Health Aspects. Solid Waste Management, E - Waste Management & Biomedical Waste Management - Sources, Characteristics & Disposal methods. Effects of human activities on the environment. Self-Learning and Termwork: • CPCB guidelines for air, water, and noise • Wastewater discharge standards	**6**
4	Sustainable Development – Principle of Sustainability, Measurement of sustainability, utilization of natural resources, Challenges to sustainable development. Biodiversity – Important kinds of biodiversity, Degree of diversity in an ecosystem, threats to biodiversity. Self-Learning and Termwork: • Solving numerical problems on diversity indices • community outreach activities • Restoration strategies	**6**

5	Environmental Acts & Regulations - Air and Water Act, Environment related organization, Environment Impact Assessment, Role of Non-Governmental Organizations (NGOs), NGT. Self-Learning and Termwork: • Amendments • Case studies • Visit NGO's and report preparation	4

Text Books:

- Benny Joseph. "Environmental Studies", Tata McGraw–Hill Publishing Company Limited. 2005.
- Ranjit Daniels R.J. and Jagadish Krishnaswamy. "Environmental Studies", Wiley India Private Ltd., New Delhi.2009.
- Rajagopalan R., "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005.
- Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt., Ltd., 2012.

Reference Books:

- Raman Sivakumar, "Principals of Environmental Science and Engineering", 2nd Edition, Cengage Learning Singapore, 2005.
- Meenakshi P., "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006.
- Prakash S.M., "Environmental Studies", Elite Publishers Mangalore, 2007.
- Erach Bharucha, "Textbook of Environmental Studies", for UGC, University Press, 2005.
- Tyler Miller Jr G., "Environmental Science – working with the Earth", 11th Edition, Thomson Brooks, Cole, 2006.

Journals/Magazine

Technical articles from peer-reviewed journals of Science Direct, acs.org, Springer, Taylor and Francis, and patented materials.

Course Articulation Matrix:

COs↓	PROGRAM OUTCOMES										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	-	--	-	-	3	-	3	3	-	3
CO2	3	1	-	2	-	3	-	3	3	-	3
CO3	3	-	-		-	3	3	3	3	-	3
CO4	3	-	-	2	-	3	3	3	3	-	3
CO5	3	-	-		-	3	3	3	3	-	3

High – 3, Medium – 2, Low – 1

IV Semester

(Non-Credit Course)

(For Lateral Entry Students)

<table>
<tr><td>DEPARTMENT</td><td colspan="7">Mathematics</td></tr>
<tr><td>Course Code</td><td colspan="2">24MATDIP410</td><td>Total Credits</td><td>00</td><td>Course Type</td><td colspan="2">Theory (Basic Science Course)</td></tr>
<tr><td>Course Title</td><td colspan="7">Foundations of Engineering Mathematics-II (For IV Semester Lateral Entry Students)</td></tr>
<tr><td rowspan="5">Teaching Learning Process</td><td></td><td>Contact Hours</td><td>Credits</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>03</td><td>00</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>00</td><td>00</td><td>Weightage</td><td>--</td><td>100 %</td><td>100%</td></tr>
<tr><td>Practical</td><td>--</td><td>--</td><td>Maximum Marks</td><td>--</td><td>60</td><td>60 Marks</td></tr>
<tr><td>Total</td><td>03</td><td>00</td><td>Minimum Marks</td><td>--</td><td>24</td><td>24 Marks</td></tr>
</table>

Pre requisites: Basics in differential calculus, Integral calculus and vectors.

Course objective: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and Engineering phenomena.
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals.

Course Outcomes: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Explain various physical models through higher order differential equations and solve such linear ordinary differential equations.	L2
CO2	Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions.	L2
CO3	Apply the concept of Laplace transform in solving Linear Differential equations.	L2
CO4	Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method.	L2
CO5	Apply the concept of to evaluate multiple integrals and Beta and Gamma functions	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Syllabus:

UNIT No.	Content	Lecture Hours
UNIT 1	**Linear Differential Equations:** Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters.	8
UNIT 2	**Laplace Transform:** Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t), t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Integrals. Laplace Transform of Periodic functions.	8
UNIT 3	**Inverse Laplace Transform:** Inverse Laplace Transform, Convolution theorem (without proof) and problems. Applications –Solution of Linear differential equations using Laplace Transform.	7
UNIT 4	**Elementary Numerical Methods:** Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.	8
UNIT 5	**Integral Calculus:** Multiple integrals –Evaluation of double and triple Integrals, Beta and Gamma functions: Definition, relation between Beta and Gamma functions and simple problems.	8

Text Books:

Sl. No	Author/s	Title	Publisher Details
1	B.S. Grewal	Higher Engineering Mathematics	44th Edition, 2015, Khanna Publishers, ISBN: 978- 81-933284-9-1.
2	E. Kreyszig	Advanced Engineering Mathematics	10th Edition (Reprint), 2016, John Wiley & Sons, ISBN: 978-0470458365
3	M.K. Jain, S.R.K. Iyenger and R.K. Jain	Numerical methods for scientific and engineering computation	6th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235

Reference Books:

Sl.No.	Author/s	Title	Publisher Details
1	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics	Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019, ISBN: 9789352743766, 9789352743766.
2	Maurice D. Weir, Joel R. Hass and George B. Thomas,	Thomas' calculus: Early Transcendentals	12th edition, Pearson Education, 2016. ISBN: 978-07802-426-9.
3	B. V. Ramana	Higher Engineering Mathematics	11th edition, Tata-McGraw Hill, 2010, ISBN:0-07-053516-7.
4	Peter V.O 'Neil	Advanced Engineering Mathematics	7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012, ISBN: 978- 81-315-0310-2.

Web/Digital resources:

Sl.No.	Web Link
1	https://www.classcentral.com/subject/maths
2	https://academicearth.org/

Course Articulation Matrix:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3										
CO3	3										
CO4	3										
CO5	3										

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

Text Books:

Sl. No	Author/s	Title	Publisher Details
1	B.S. Grewal	Higher Engineering Mathematics	44th Edition, 2015, Khanna Publishers, ISBN: 978- 81-933284-9-1.
2	E. Kreyszig	Advanced Engineering Mathematics	10th Edition (Reprint), 2016, John Wiley & Sons, ISBN: 978-0470458365
3	M.K. Jain, S.R.K. Iyenger and R.K. Jain	Numerical methods for scientific and engineering computation	6th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235

Reference Books:

Sl.No.	Author/s	Title	Publisher Details
1	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics	Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019, ISBN: 9789352743766, 9789352743766.
2	Maurice D. Weir, Joel R. Hass and George B. Thomas,	Thomas' calculus: Early Transcendentals	12th edition, Pearson Education, 2016. ISBN: 978-07802-426-9.
3	B. V. Ramana	Higher Engineering Mathematics	11th edition, Tata-McGraw Hill, 2010, ISBN:0-07-053516-7.
4	Peter V.O 'Neil	Advanced Engineering Mathematics	7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012, ISBN: 978- 81-315-0310-2.

Web/Digital resources:

Sl.No.	Web Link
1	https://www.classcentral.com/subject/maths
2	https://academicearth.org/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3										
CO3	3	1									
CO4	3	1									
CO5	3	1									

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

PO2: ability to analyze engineering problems

FOURTH SEMESTER						
Course Code: 24MA411	Engineering Mathematics-IV (Common to CV, MECH, IP, ENV, CTM and PST)					
Total Credits: 03 *L-45: T-0: P-0: SL and TW-45*	*SDGs addressed: 4, 5, 9, 16, 17*		*Course Category: Basic Science Course*	*Course Type: Theory*		
Teaching Learning Process		*Total Contact Hours/semester*	*Assessment* *Weightage and Marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	*40*	*60*	*100*
	Practical	-	*MaximumMarks*	*40*	*60*	*100*
	Self-learning and Teamwork	45	*MinimumMarks*	*20*	*25*	*45**
	Total	90				

Note: *For passing the student must score a Minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Course Pre-Requisite: Engineering Mathematics-I, II and III

Course Objective: This course will enable students to:

1. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
2. To introduce the basic concepts and applications of probability in engineering.
3. Provide the knowledge about the random variable, random process and how to model the random processes in engineering.
4. Deal with multiple random variables and introduction of the most important types of stochastic processes.
5. To investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.

Course Outcomes (COs):

After the completion of this course, students will be able to:

CO	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data.	L2	WK1, WK3
CO2	Analyze the nature of the events and hence determine the appropriate probabilities of the events.	L2	WK2, WK4
CO3	Classify the random variables to determine the appropriate probability distributions	L2	WK1, WK3
CO4	Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix and fixed probability vector for a given Markov chain.	L3	WK4, WK8
CO5	Estimate the parameter of a population, important role of normal distribution as a sampling distribution.	L2	WK2, WK9

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Syllabus:

Unit No.	Content	Lecture Hrs
1	**Statistics:** Introduction, Definitions, Curve Fitting: Straight line, parabola and exponential curves. Correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **Self-Learning and Teamwork** • Fitting of Exponential curve $y=ab^x$ • Describe the principle of least squares	**09**
2	**Probability:** Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem. **Self-Learning and Teamwork** • Recapitulation of set theory • Empirical definition of probability	**09**
3	**Random Variables:** Discrete Probability distribution, Continuous Probability distribution, expectation, Variance, Probability generating function, Binomial distribution, Poisson distribution, Normal distribution. **Self-Learning and Teamwork** • Discrete and Continuous random variables: Definitions, Examples • Derive Mean and Standard Deviation of the Poisson Distribution • Application of Normal Distribution	**09**
4	**Joint probability distribution:** Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular markov chains and absorbing states. **Self-Learning and Teamwork** • Examples on continuous random variables • Classification of Stochastic Processes: Discrete state process, continuous state process • Examples of Finding Stationary Distribution of Markov Chain	**09**
5	**Sampling Distribution:** Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples, Student's t-distribution. **Self-Learning and Teamwork** • Real life examples for statistical inference • Test of significance for difference of means	**09**

Text Books:

Sl. No	Author/s	Title	Publisher Details
1	B.S. Grewal	Higher Engineering Mathematics	44th Edition, Khanna Publishers, 2015
2	Ralph P. Grimaldi	Discrete and Combinatorial Mathematics	4th Edition, PHI/Pearson Education, 2005
3	E. Kreyszig,	Advanced Engineering Mathematics	10th Edition (Reprint), John Wiley & Sons, 2016

Reference Books:

Sl.No.	Author/s	Title	Publisher Details
1	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics	Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019
2	Alan Tucker	Applied Combinatorics	5th Edition, Wiley-India, 2011
3	Maurice D. Weir, Joel R. Hass and George B. Thomas	Thomas' calculus: Early Transcendentals,	12th edition, Pearson Education, 2016
4	B. V. Ramana	Higher Engineering Mathematics	11th edition, Tata-McGraw Hill, 2010
5	Peter V.O 'Neil	Advanced Engineering Mathematics	7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012

Web/Digital resources:

Sl.No.	Web Link
1	https://www.classcentral.com/subject/maths
2	https://academicearth.org/

Course Articulation:

PO'S→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3										
CO3	3										
CO4	3	1									
CO5	3										

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

PO2: ability to analyze engineering problems

Fourth Semester
(From the Academic Year 2024-25)

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP410</td><td colspan="4">Course Title: Material Science and Metallurgy</td></tr>
<tr><td colspan="3">Total Credits: 04
L- 45: T- 0: P-15 : SL and TW-60</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="3">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Practical</td><td>15</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td colspan="2">Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: This course will enable students to:

Student will learn different materials and its properties, material structure and mechanical behavior under various temperatures.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the Structure of Solids and Diffusion Mechanism	L1, L2	WK1 to WK4
CO2	Illustrate the Mechanical Behavior of Materials and Fracture , Fatigue, Creep	L1, L2	WK1 to WK4
CO3	Demonstrate solidification of Metal Alloys and Phase diagrams	L1, L2	WK1 to WK4
CO4	Describe the Iron Carbon Systems / Diagrams TTT diagram and CCC diagram, Heat treatment of steels and ferrous & Non ferrous Materials	L1, L2	WK1 TO WK4
CO5	Design the mechanical properties of materials like hardness , toughness, strength, stiffness etc, Expound the various testing devices to measure hardness, impact strength, tensile strength,bending and shear strength , Compressive of metallic and non- metallic materials	L1, L2,L3	WK1 TO WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Structure of solids: classification, Bravais space lattice, Miller indices. X-ray diffraction, Bragg's law, problems related to density calculation. Crystal imperfections. Diffusion: Mechanism, Fick's 1st and 2nd Laws of diffusion, types of diffusion factors affecting diffusion, Application. *Self-Learning and Teamwork:* • Study on Structure of solids, Bravais space lattice	08	--
2	Mechanical Behaviour of Materials: Mechanism of elastic action, Relationship between stress and strain. Linear and nonlinear elastic properties, inelastic properties, conventional stress, and true stress, conventional strain and true strain plastic deformation by slip and twinning strain hardening, re crystallization and grain growth Fracture, Fatigue and Creep: Introduction to Griffith Theory, Fracture toughness, Fatigue Fracture. Creep- Definition, stages of creep, creep properties. Fatigue – Definition, S-N Diagram, Fatigue properties, factor affecting fatigue strength. *Self-Learning and Teamwork:* • Application /practice of Mechanical Behavior of Materials • Application of Linear and nonlinear elastic properties, inelastic properties • Fracture, Fatigue and Creep	08	--
3	Solidification of metal alloys: Definition, nucleation and its types, crystal growth, cast metal structures. Phase Diagrams: Solid solutions, Hume – Rothery principles, Gibb's phase rule, types of phase diagrams and their constructions, problems on equilibrium diagrams *Self-Learning and Teamwork:* • Application /Practice of Solidification of metal alloys, Cast metal structures • Application / Practice Phase Diagrams	08	-- --
4	Iron carbon systems: Solidification of pure iron, construction of Fe- C equilibrium diagram, types of phases, invariant reactions, TTT diagram and continuous cooling curves. *Self-Learning and Teamwork:* • Applications of Iron carbon systems, Fe- C equilibrium diagram • *Applications of /Practice*- TTT diagram and continuous cooling curves.	07	--

5	Heat treatment of Steels: Need, purpose, process- annealing, normalizing, hardening, tempering , mar-tempering, aus- tempering, Hardenability, surface heat treatments- carburizing, nitriding and cyaniding. Ferrous and nonferrous materials: Properties composition and applications of steel C.I, copper alloys, aluminum alloys. Advanced Materials - Composites, its classification, brief knowledge about metal matrix and polymer matrix composites, ceramics and their types, memory alloys *Self-Learning and Teamwork:* • Shape memory alloys	08	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs.] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Course Content / Syllabus(Laboratory):

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	**Hardness Test:** Estimating the Hardness of different Engineering materials Using Brinell's & Rockwell Hardness Testers.	-	-	06
2	**Impact Test:** Determining the impact strength for a given material using Charpy & IZOD tests			06
3	**Tension Tests using Universal Testing Machine:** Tension test on the given specimens (at least 2 materials for comparison) and to plot the stress straingraphs	-	-	06
4	**Compression Tests using Universal Testing Machine:** Compression test on the given specimens (at least 2 materials for comparison) and to plot the stress strain graphs			06
5	**Bending and Double Shear Tests using Universal Testing Machine:** Bending test, Double Shear test on the given specimens (at least 2 materials for comparison) and to plot the stress strain graphs.			06

** NOTE : Practical Component is only considered for CIE – INTERNAL ASSESSMENT / SEE –SEMESTER END EXAMS

TEXT BOOKS:

1. Manufacturing process –II by
2. Radhakrishna Production technology by HMT. Material Science and processes: Hazra S.K. & Choudhary, Media promoters and Publishers PvtLtd.
3. Physical Metallurgy- Y. Lakhitin, Mir Pub.

REFERENCE BOOKS:

1. Material Science and processes: Dr. M.K. Muralidhara, Dhanpath Rai publication Company, New Delhi.
2. Elements of Material Science and Engineering: Van Vlack H & Lawrence, Addison Wesley Publication.
3. Material Science and Engineering : William D. Callister Jr, John Wiley & sons Inc.
4. Materials Science – V.Richards
5. Material Science and Engineering : V. Raghavan Prentice Hall of India, New Delhi

Web/Digital resources:

http://www.istl.org

https://www.materilstody.com

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

INTEGRATED LAB

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1
CO3	3	3	3		3	3					3	3	2	1
CO4	3	3	3		3	3					3	3	2	1
CO5	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP420</td><td colspan="5">Course Title: MECHANICS OF MATERIALS</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T-15 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>15</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Strength of Materials

COURSE PREREQUISITE: ENGINEERING MECHANICS

Course Objective:

To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.

- To know the behavior & properties of engineering materials.
- To understand the stresses developed in bars, compound bars, beams, shafts, and cylinders.
- To understand the concepts of calculation of shear force and bending moment for beams with different supports.
- To expose the students to concepts of Buckling of columns and strain energy.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the simple, compound, stresses and strains their relations and strain energy.	L2,L3	WK1 TO WK6
CO2	Analyze structural members for stresses, strains and deformations.	L3, L4	WK1 TO WK6
CO3	Analyze the structural members subjected to bending and shear loads for beams.	L3, L4	WK1 TO WK6
CO4	Analyze shafts subjected to twisting loads.	L3, L4	WK1 TO WK6
CO5	Analyze the short columns for stability.	L3, L4	WK1 TO WK6

L1– Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Stresses and Strains:** Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress-strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them**.** *Self-Learning and Teamwork:* • Write down the force/elongation equations	**08**	**02**
2	**Analysis of Stress and Strain:** Introduction to three-dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear stress, **Cylinders:** Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations *Self-Learning and Teamwork:* • Study on examples of Strain Gauges	**08**	**02**
3	**Shear Force and Bending Moment:** Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads. **Stress in Beams:** Bending and shear stress distribution in rectangular, I and T section beams. *Self-Learning and Teamwork:* • Examples on Bending Moment diagram(BMD) and shear force diagram(SFD)	**08**	**03**
4	**Theories of Failure:** Maximum Principal stress theory, Maximum shear stress theory. **Torsion:** Circular solid and hollow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections. *Self-Learning and Teamwork:* • Fracture theory	**08**	**03**
5	**Columns:** Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns. **Strain Energy:** Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and II *Self-Learning and Teamwork:* • Analysis of Buckling and stability for columns .	**07**	**03**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. R.S. Khurmi, N Kurmi "Strength of Materials", S Chand Publications–26th Edition, 2019
2. Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnston, 7th Ed, TATA McGrawHill-2014
3. Mechanics of Materials, K. V. Rao, G. C. Raju, Subhash Stores, 2012 Edition

Reference Books:

1. Strength of Materials, S. S. Bhavikatti, Vikas Publishing House-Pvt. Ltd., 4th Ed. 2013
2. A Text book of Strength of Materials, R. K. Bansal, Laxmi Publications, 2010.
3. Strength of Materials, W. A. Nash, Schaum's Outline Series, Fourth Edition-2007
4. Mechanics of Materials, R. C. Hibbeler, Prentice Hall, Pearson Edu., 2005

Web/Digital resources:

1. https://nptel.ac.in/courses/105/106/105106172/

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	3	3		3	3						3	2	1
CO2	3	3	3		3	3						3	2	1
CO3	3	3	3		3	3						3	2	1
CO4	3	3	3		3	3						3	2	1
CO5	3	3	3		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP430</td><td colspan="5">Course Title: Elements of Production Engineering</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T- 0: P-15 : SL and TW-60</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>15</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre requisites: Elements of mechanical Engineering

Course objectives: This course will enable students to:

1. To introduce the concept of manufacturing process.
2. To introduce the concept of manufacturing methods, different kinds of products.
3. To introduce the concept of Casting process and Special methods of casting with Welding technology.
4. To make the student to known the molten metal's. core and pattern molding flasks
5. To find the solidification time for casting process.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Describe and identify traditional manufacturing methods like shaping, casting..etc.,	L3	WK1 to WK6
CO2	Expound the special casting methods like centrifugal, investment	L3	WK1 to WK6
CO3	Explain the knowledge of welding processes with different special welding process	L3	WK1 to WK6
CO4	Explain the Metallurgical concepts in welding (HAZ)	L2	WK1 TO WK4
CO5	Illustrate the concepts of NDT, brazing and soldering for different applications.	L2	WK1 TO WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Casting Process**: Introduction: Concept of Manufacturing process. Importance, Classifications of manufacturing process, Introduction to casting process, steps involving casting process, varieties of product producing casting process, merits and demerits of casting process and applications of casting, Concept of pattern, allowances Patterns: Functions- material used for pattern allowances & their importance, classifications & patterns, casting defects- Causes features & remedies. Moulding Machines: Jolt type, Squeeze type sand slinger. *Self learning and Team Work:* • IN INDUSTRY – the Merits and demerits of casting	09	--
2	**Sand Moulding:** Types base sand requirement of base sand, types of sand mould. Sand moulds: Moulding sand (base sand) binder & additives, Methods used for sand moulding. Special Moulding process: Green sand moulding, Sweep moulding CO2Mould, Shell Mould, investment mould Metal Moulds: Gravity die casting pressure die casting *Self learning and Team Work:* • Industrial applications on types of Sand Moulding.	09	--
3	**Welding process:** Definition principles of welding, classification of welding applications of merits and demerits of welding. Filler rods fluxes: Defection causes and remedies of well defects Arc Welding- Principle of Arc welding, Metal arc welding (MAW) FSMAW, Inert gas welding (GMAW). Gas welding - Principle of gas welding or Oxy - Acetylene welding. Special Types of welding- Resistance welding, Principle of resistance welding, types of resistance welding- seam welding, butt welding projection welding. Friction Welding - Laser welding, Electron Welding. *Self learning and Team Work:* • In Industry –the Merits and demerits of welding	09	--
4	**Metallurgical concepts in welding:** Definition, concept of different zones formed during welding heat affected zones (HAZ) Factors affecting zone *Self learning and Team Work:* • Basic concepts of Welding metallurgy	09	--
5	**Principles of soldering brazing and adhesive bonding:** Different types of soldering brazing adhesive bonding methods Inspections of Testing of welding**.** **Non Destructive Methods:** Introduction, different types of nondestructive testing: visual magnetic particle testing & Ultrasonic Radiography *Self learning and Team Work:* • Applications of different types of Non Destructive testing in industries.	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs] is only considered for CIE – INTERNAL ASSESSMENT

not for SEE –SEMESTER END EXAMS

Content / Syllabus (Laboratory):

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	Foundry laboratory 1. Practical cases on the preparation of moulds, mould cavity, using manual type & Patterns. 2. Permeability (demonstration) and compression Test on foundry sand & plot the characteristics graphs.	-	-	20
2	Sheet metal practice (minimum 2 exercises)	-	-	10

** NOTE : Practical Component is only considered for CIE – INTERNAL ASSESSMENT /SEE –SEMESTER END EXAMS

TEXT BOOKS:

1. **Manufacturing Technology** - Foundry forming welding by P.N.Rao Second edition.
2. **Manufacturing Process**-I - A.C.Niranjan – Pooja publications.
3. **Manufacturing Process-I** - Dr. K.Radhakrisha. Fifth Editions
4. **Manufacturing Process** - H.D.Ramachandra
5. **Elements of Workshop technology** by Hajra Choudhary vol 1,2, and 3
6. **Foundry technology** by O.P. Khanna

REFERENCE BOOKS:

1. **"Process and Materials of Manufacturing**", Roy A Lindberg, 4thEd.PearsonEdu.2012
2. **"Manufacturing Technology**", Serope Kalpakjian, Steuen. R. Sechmid, PearsonEducation Asia, 5th Ed.2012.

Web/Digital resources:

1. https://nptel.ac.in/courses/112/104/112104301/

2. https://nptel.ac.in/courses/112/107/112107078/

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	3	3		3	3						3	2	1
CO2	3	3	3		3	3						3	2	1
CO3	3	3	3		3	3						3	2	1
CO4	3	3										3	2	1
CO5	3	3										3	2	1

High – 3, Medium – 2, Low – 1

INTEGRATED LAB

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	3	3		3	3						3	2	2
CO2	3	3	3		3	3						3	2	2

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP440</td><td colspan="5">Course Title: Thermal Engineering</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T- 15: P-0 : SL and TW-60</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: The main objective of this course is to make students familiar with the basic concepts of thermodynamics, laws of thermodynamics, the working of air compressors, Air standard cycles, Vapour cycles and steam Nozzles and to introduce the basic principles of classical thermodynamics for solving engineering problems.

COURSE OUTCOME: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the basic concepts of Thermodynamics and to apply the principles of first and second laws of Thermodynamics.	L1, L2, L3	WK1 to WK6
CO2	Apply the principles prevailing in perfect gases and to study the various characteristics of different thermodynamic processes.	L1, L2, L3	WK1 to WK6
CO3	Illustrate the working principles of air compressors with numerical problems.	L1, L2, L3	WK1 to WK6
CO4	Explain the basic concepts of air standard with numerical examples.	L1, L2, L3	WK1 to WK6
CO5	Illustrate the basic concepts of the working principles of and vapour power cycles with numerical examples.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Basic concepts: Introduction, Thermodynamic systems,** surroundings, Homogenous and Heterogenous system, Microscopic and Macroscopic point of view, thermodynamic equilibrium, properties of the system, First law of thermodynamics for a change in state of a closed system, Internal energy of an ideal gas, Enthalphy, problems on First law of thermodynamics for closed system. **Second law of Thermodynamics:** Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. reversible and irreversible processes. Kelvin Planck statement, Clausius statement of Second law of Thermodynamics, Equivalence of the Kelvin Planck statement and Clausius statement. *Self-Learning and Teamwork:* Applications on First law of thermodynamics.	09	--
2	**Perfect gases:** Characteristic equation specific heat of perfect gases, The universal gas constant. Pure substance properties – temperature of saturation. Enthalpy, dryness fraction, specific volume, latent heat, entropy, with reference to a pure substance such as water and its vapour. Super-heated vapour, Determination of dryness fraction of steam, Heating process of pure substances: constant volume, constant pressure, Isothermal, Hyperbolic, Adiabatic, Polytrophic and Throttling process, Problems *Self-Learning and Teamwork:* • *Industrial and Scientific applications on Ideal gas law.*	09	--
3	**Air compressors:** Introduction, classification, Reciprocating compressor- effect of the type of compression, work done in a single stage compressor neglecting clearance, effect of clearance volume, volumetric efficiency, multistage compression, work done in a two stage compressor, condition for minimum power in a two stage compressor with perfect intercooling, Free air delivery, Problems *Self-Learning and Teamwork:* • Types and uses of Industrial Air compressor	09	--
4	**Air Standard cycles:** Derivations of Otto cycle, diesel cycle, Dual combustion cycle, cycle, Brayton cycle. Numerical Problems *Self-Learning and Teamwork:* • Comparison between Otto cycle, diesel cycle, Dual combustion cycle.	09	–
5	**Vapour power cycles**: Carnot, Rankine cycle, Regenerative and Reheat cycles, Refrigeration Cycle: Refrigeration by non-cyclic Processes, Vapour compression refrigeration cycle, Absorption refrigeration Cycle- Problems *Self-Learning and Teamwork:* • Comparison between Carnot and Rankine cycle.	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Basic and Applied Thermodynamics P.K.Nag, Tata McGraw Hill 2nd Ed., 2002
2. Basic Engineering Thermodynamics A.Venkatesh Universities Press, 2008
3. Basic Thermodynamics, B.K Venkanna, Swati B. Wadavadagi PHI, New Delhi 2010

Reference Books:

1. Thermodynamics- An Engineering Approach YunusA.Cenegal and Michael A.Boles Tata McGraw Hill publications 2002
2. An Introduction to Thermodynamcis Y.V.C.Rao Wiley Eastern 1993,
3. Thermodynamics & Heat Engines by Domkundwar
4. Engineering Thermodynamics .B.Jones and G.A.Hawkins John Wiley and Sons.
5. Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner
6. Thermodynamics – Arora IIT Delhi Tata hill publication

DATA HAND BOOK:

1. Thermodynamic data hand book, B.T.Nijaguna.
2. Properties of Refrigerant & Psychometric (tables & Charts in SI Units), Dr. S.S.Banwait, Dr.
   S.C. Laroiya, Birla Pub. Pvt. Ltd., Delhi,2008

Web/Digital resources:

1. https://nptel.ac.in/courses/112/105/112105266/
2. https://nptel.ac.in/courses/112/104/112104113/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3								3	3	1	1
CO2	3	3	3								3	3	1	1
CO3	3	3	3								3	3	1	1
CO4	3	3	3								3	3	1	1
CO5	3	3	3								3	3	1	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP451OE</td><td colspan="4">Course Title: Computer Aided Design</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC I</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

To understand the role of computers in design, manufacturing and in product life cycle, basic hardware structure, understand configuration of graphics system, geometric modelling, concept of assembly design, modelling of exchange data and role of computers in process planning and inspection.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the role of computers in design, manufacturing product life cycle, usage of hardware in computers.	L1, L2	WK1 to WK4
CO2	Illustrate software configuration of graphics system, geometric modelling, and solid modelling techniques.	L1, L2, L3	WK1 to WK6
CO3	Illustrate the assembly design, various Boolean operations, model tree, parent child relationship and other modelling features.	L1, L2,L3	WK1 to WK6
CO4	Explain different surface modelling techniques and modelling of exchange of data.	L1, L2, L3	WK1 to WK6
CO5	Explain the role of computers in process planning and in inspection.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction**: Role of computers in design and manufacturing, Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. The role of CAD in Product Life Cycle Management **Hardware for CAD**: Usage and types of hardware for CAD – input devices, display devices, printing, plotting devices and other hardware interface devices. *Self-Learning and Teamwork:* • The role of CAD in Product Life Cycle Management • Hardware for CAD: Usage and types of hardware for CAD	09	-
2	**Computer graphics**: Software configuration of a graphic system, functions of a graphic package, construction geometry, wire frame and solid modeling, 2D linear, rotational, Transformations problems. **Geometric Modeling:** Functions of geometric modeling, properties of geometric modeling. **Solid modeling techniques:** Brief history of solid modeling, **CSG** – primitives, Boolean operations, modeling, B-rep – face, edge & vertex representations, topological considerations, manifold & non-manifold solids, Sweep representations. modeling, viewing features. *Self-Learning and Teamwork:* • Software configuration of a graphic system (wire frame and solid modeling) • Geometric Modeling • Solid modeling techniques (**CSG** – primitives, Boolean operations, modeling, B-rep – face, edge & vertex representations)	09	-
3	**Theory of Assembly design:** Basic concepts, Boolean operations in Assembly practice, part models, subassembly, relationships, associatively, constraints, manipulations, Assembly drawings, Part-listing, motions & DOF, determining material properties. Use of Model Tree, Parent-Child relationships, re-order synchronous modeling features *Self-Learning and Teamwork:* • Key aspects of model tree with examples.	09	-
4	**Automotive Design:** Using tab surface, ruled surface and other surface modeling techniques **Exchange of modeling data**- Transition from drafting to designing with examples and discussions of basic features of IGES, STEP, DXF, DMIS and its applications *Self-Learning and Teamwork:* • Applications of IGES, STEP, DXF, DMIS.	09	-

5	**Computer Aided Process Planning :** Role of process planning in CAD/CAM Integration, Development, Benefits, Model and Architecture , CAPP Approaches - Variant, Generative and Hybrid Process Planning systems, Criteria in selecting a CAPP System. **Computer Aided Inspection:** Engineering Tolerances, Need for Tolerances, Conventional Tolerances, FITS and LIMITS, Tolerance Accumulation and Surface quality, Geometric Tolerances, Tolerances Practices in design, Drafting and manufacturing, Tolerance Analysis , Tolerance synthesis *Self-Learning and Teamwork:* • Industrial applications of Computer Aided Inspection.	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. CAD/CAM principles and applications by P N Rao
2. CAD/CAM by Groover.

Reference Books:

1. Introduction to design & analysis of algorithms - S.E.Goodman, S.T.Headetmiemi
2. Principles of interactive computer graphics by Newman & Sproul
3. Computer graphics by Steven Harrington
4. CAD-CAM by ChrisMcMahon & JimmieBrowne
5. CAD-CAM by IbrahimZeid

Web resources:

1. https://nptel.ac.in/courses/112/104/112104031/

Course Articulation:

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									3	3	2	1
CO2	3	3	2	2	2						3	3	2	1
CO3	3	3	2	2	2						3	3	2	1
CO4	3	3	2	2	2						3	3	2	1
CO5	3	3	2	2	2						3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP452OE</td><td colspan="3">Course Title: Non Destructive Testing</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC I</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Course Pre requisite: Nil

Course objectives: Students will get an insight on different non-destructive testing techniques and applications in various industries

Course outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain selection of non-destructive methods and Common NDT Methods, Recent NDT Methods	L1,L2	WK1 to WK4
CO2	Illustrate magnetic particle Inspection Methods and Eddy Current Inspection	L1,L2	WK1 to WK4
CO3	Describe the Principle Operation of Ultrasonic Inspection and Practical Applications with Case study of Human Body	L1,L2	WK1 to WK4
CO4	Explain Radiographic inspection its Principles and Practical applications with case Study on - X – ray of Human body	L1,L2	WK1 to WK4
CO5	Illustrate industrial Computed Tomography and Case Studies of Eddy Current Inspection	L1,L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 Create

Course Content / Syllabus:

UNT No.	Content	Hours	
		Lecture	Tutorial
1	**INTRODUCTION to Non-Destructive [ND] TESTING:** Selection of ND methods, Scope and advantages of NDT. Comparison of NDT with DT Some common NDT methods used since ages, Flaws and Defects Terminology. Common NDT Methods /Recent NDT Methods Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test. *Self-Learning and Teamwork:* • Application with Comparison of NDT with DT.	09	-
2	**Magnetic Particle Inspection:** Methods of generating magnetic fields – types of magnetic particles and suspension liquids – steps in inspection. application and limitations. Eddy Current Inspection: Principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications. *Self-Learning and Teamwork:* • Application of Magnetic Particle Inspection • Study of various inspection methods and procedures with applications.	09	-
3	**Ultrasonic Inspection:** Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, Basic equipment characteristics of ultrasonic waves, variables in inspection, inspection methods – Pulse Echo A, B, C, scans, transmission, resonance techniques, transducer elements, couplets, search units, contact types and immersion types. CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. *Self-Learning and Teamwork:* • Case Study – Ultra Sonography of Human Body.	09	-

4	**Radiographic Inspection:** Principles, radiation sources, X-Rays and gamma rays: X - Rays tubes, radio graphic films, screens and filters, image intensifiers, technique charts, industrial radiography, electro-radiography, image quality, radiographic sensitivity, electron neutron radiography. X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of y-ray radiography – principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of Y-ray radiography over X-ray Radiography Precautions against radiation hazards. *Self-Learning and Teamwork:* Case Study — X-ray of Human Body**.**	09	-
5	**Industrial Computed Tomography:** Basic principles, capabilities, and comparison with other NDE methods – application of ICT. Thermal inspection principles, equipment inspection methods applications. *Self-Learning and Teamwork:* • Applications Industrial Computed Tomography	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation. 2. Research Techniques in NDT Vol.3, R.S. Shah, Academic

Reference Books:

1. Industrial Quality Control, Web star.
2. Bray, Don E .and Stanley, Roderick K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service, CRC Press New York

Web/Digital resources:

1. https://www.wermac.org (Non Destructive Testing - Radiographic Testing (RT) – Wermac)
   2. https://www.twi-global.com (Radiography Testing - NDT Inspection - TWI Global).
3. https://www.flyability.com (NDT (Non-Destructive Testing): A Complete Guide – Flyability)

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP453OE</td><td colspan="4">Course Title: Composite Materials</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: OECI</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="3">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL

COURSE OBJECTIVE: This course will enable students to:

To impress the student about the study and analysis of composite materials, processing, and fabrication aspects. It also discusses some important care to be taken up in fabricating ceramic matrix composites.

COURSE OUTCOMES (COs): After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the classification and Characteristics of Composite Materials	L1, L2	WK1 to WK4
CO2	Describe the Manufacturing Methods of Metal Matrix Composites -MMC	L1, L2	WK1 to WK4
CO3	Describe The Manufacturing Methods of Polymer Matrix Composites PMC	L1, L2	WK1 to WK4
CO4	Describe The Manufacturing Methods of Ceramic Matrix Composites CMC	L1, L2,	WK1 to WK4
CO5	Illustrate the advanced Composites Materials , Nano Composites, Shape Memory Alloy Materials	L1, L2,	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Definitions: Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fiber composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites. *Self-Learning and Teamwork:* • Examples of composites used in automobiles	9	
2	Metal matrix composites and manufacturing methods, Joining methods and process/failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Metal matrix composites	9	
3	Polymer Matrix composites (PMC)- Manufacturing process, failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Polymer Matrix composites	9	
4	Ceramic matrix composites (CMC): Manufacturing process, failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Ceramic matrix composites	9	
5	Advanced Composites – polymer based Sandwich Structure, Nano composites, Introduction to Shape memory Alloys *Self-Learning and Teamwork:* • Applications of Advanced Composites.	9	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text books:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York
2. Mechanics of composite materials by Autar Kaw, CRC Press
3. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall
4. Composite materials by J.N. Reddy

Reference Books:

1. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
2. Frank L Matthews and RD Rawlings, (2006), Composite Materials:
3. Engineering and Science, Taylor and Francis D. Hull and T.W. Clyne, (1996), Introduction to Composite Materials, Cambridge University

Web Resources:

1. https://nptel.ac.in/courses/112104229

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP46L		*Course Title: Computer Aided Design Lab*				
Total Credits: 04 L- 0: T- 0: P-45 : SL and TW-0		SDGs addressed: 4, 9 & 12			*Course Category: PCCL*	Course Type: *Laboratory*
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	-		CIE	SEE	Total
	Tutorial	-	*Weightage %*	*40*	*60*	*100*
	Practical	45	*Maximum Marks*	*40*	*60*	*100*
	Self-Learning and Teamwork	-	*Minimum Marks*	*20*	*25*	*45**
	Total	45				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: This course will enable students to:

To impress the student about drawing practices & to learn the methods of drawing using Unigraphics NX software

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Create and Develop the Concepts of Primitives 2 Dimensional , 3Dimensional Drawings	L3, L6	WK1 to WK6
CO2	Create and Develop the Model Tree , Surface Modeling, Solid Modeling , Assembly	L3, L6	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	Solid Modeling of simple machine components using CAD packages: Suggested Software Packages like UGS/NX– Exercises: Familiarize with Unigraphics NX - basic Commands [Simple solid surfaces] for practice not for exams. 1. To Create -Orthographic Solid Components 10 Exercises [given] 2. To Create Solid Model(s) by given dimension /Specifications in mm - Siren Cap, Turbine Blade, Coffee Mug, Elbow.	-	-	30
2	To Create Surface Modeling using NX-Uni Graphics - Sheet Surface Mould, To Create Assembly - Hexagonal Bolt and Nut Assembly.	-	-	15

TEXT/REFERENCE BOOKS

1. CAD/CAM principles and applications by P NRao
2. CAD/CAM by Grover,
3. Introduction to design & analysis of algorithms - S.E.Goodman,S.T.Headetmiemi
4. Principles of interactive computer graphics by Newman &Sproul
5. CAD-CAM by ChrisMcMahon& Jimmie Browne
6. CAD-CAM by Ibrahim Zeid Any other reference material like manufacturer's catalogues, journals etc.,

Web/Digital resources:

https://www.youtube.com/watch?v=aMDKGXV-XFo
https://www.youtube.com/watch?v=Hu-OXLD2R84
https://www.youtube.com/watch?v=V2Y0vFP1BNA
https://www.youtube.com/watch?v=1SVj7PWaKOI
https://www.youtube.com/watch?v=jTDyqH88_U8
https://www.youtube.com/watch?v=LirvZRS8lRQ
https://www.youtube.com/watch?v=IqIFS49awaU&t=16 s
https://www.youtube.com/watch?v=jML6oioL2M0

****Equivalent subject Codes : IP450L/20IP450L

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PS01	PSO2
CO1	3				3				3	3	3	3	
CO2	3				3				3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT OF HUMANITIES SCHEME & SYLLABUS

Third/Forth Semester

(From the Academic Year 2024-25)

<table>
<tr><td colspan="6">DEPARTMENT: Humanities</td></tr>
<tr><td colspan="2">Course Code:

24HU311/ 24HU411</td><td colspan="4">Course Title: Universal Human Values - II</td></tr>
<tr><td colspan="2">Total Credits: 02

L-30: T-0: P-0: SL and TW-30</td><td colspan="2">SDGs addressed: 3,4,5,6,7,8,9,10,12,13</td><td>Course Category: HSMC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact Hours/semester</td><td colspan="3">Assessment Weightage and Marks</td></tr>
<tr><td>Lecture</td><td>30</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage, %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>MaximumMarks</td><td>20</td><td>30</td><td>50</td></tr>
<tr><td>Self-learning and Termwork</td><td>30</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>60</td></tr>
<tr><td colspan="3"></td><td>MinimumMarks</td><td>10</td><td>13</td><td>23*</td></tr>
</table>

Note: *For passing the student must score a Minimum of 23 Marks (CIE+SEE: 10 + 13 or 11 + 12)

COURSE PRE-REQUISITE: Students Induction Program (desirable).

COURSE OBJECTIVES:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE OUTCOMES (COs)

By the end of the course, students will be able to:

CO	CourseOutcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand self (I) clearly through self-exploration and demonstrate natural acceptance in situations by right understanding.	L2	WK1, WK3
CO2	Distinguish between self (I) body, and co-existence of both to be in harmony.	L2	WK2, WK6
CO3	Relate to family and society by understanding nine universal human values in human- human relationship for harmony and prosperity.	L2	WK1, WK4
CO4	Explain interconnectedness and mutual fulfilment at all four orders of nature for co- existence.	L2	WK7, WK8
CO5	Develop commitment for holistic understanding of harmony by natural acceptance of human values in his/her profession and society.	L2	WK5, WK8

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Creat

Course Syllabus:

Unit No.	Content	Lecture Hours
1	**Introduction - Need, Basic Guidelines, Content and Process for Value Education** 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I. 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations. 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels. **Self-Learning and Termwork** • Identify one personal decision influenced by natural acceptance and note its effect on your choice. • Identify a campus or community issue and propose a simple solution based on harmony principles.	**06**
2	**Understanding Harmony in the Human Being - Harmony in Myself!** 7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. 8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. 9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). 10. Understanding the characteristics and activities of 'I' and harmony in 'I'. 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. 12. Programs to ensure Sanyam and Health. **Self-Learning and Termwork** • Reflect on your daily routine and identify 2–3 habits that promote harmony between your mind ('I') and body, noting their impact on well-being. • Design a simple weekly wellness plan (eg. exercises-self and body, food-self and body).	**06**
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** 13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. 14. Understanding the meaning of Trust; Difference between intention and competence 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**06**

	Self-Learning and Termwork • Reflect on a recent interaction with peers or family and identify how trust, respect, or other universal values influenced the outcome. • Prepare a flowchart or concept map showing how values in family can scale to society and the wider world.	
4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** 18. Understanding the harmony in the Nature. 19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. 21. Holistic perception of harmony at all levels of existence. **Self-Learning and Termwork** • Observe one aspect of your daily life (water, energy, waste, plants, or animals) and note how your actions impact other orders of nature. • create a diagram or model showing the interdependence of human, animal, plant, and material orders, and discuss ways to maintain balance.	**06**
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** 22. Natural acceptance of human values. 23. Definitiveness of Ethical Human Conduct. 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. 25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 26. Case studies of typical holistic technologies, management models and production systems. 27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. 28. Sum up. **Self-Learning and Termwork** • Reflect on a recent project or assignment and identify one way your technical or professional skills could contribute to eco-friendly or people-friendly solutions. • Identify one campus or community process (e.g., energy use, waste management) and propose a simple, value-based strategy to improve sustainability and social responsibility.	**06**

Text Books:

- Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

References

- Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
- The Story of Stuff (Book).
- The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
- Small is Beautiful - E. F Schumacher.
- Slow is Beautiful - Cecile Andrews
- Economy of Permanence - J C Kumarappa
- Bharat Mein Angreji Raj - PanditSunderlal
- Rediscovering India - by Dharampal
- Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
- India Wins Freedom - Maulana Abdul Kalam Azad
- Vivekananda - Romain Rolland (English)
- Gandhi - Romain Rolland (English)

Weblinks:

- https://onlineethics.org/

Course Articulation Matrix:

COURSE OUTCOMES	PROGRAM OUTCOMES										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	2	2	-	-	-
CO2	-	-	-	-	-	1	1	1	-	-	-
CO3	-	-	-	-	-	2	2	2	-	-	-
CO4	-	-	-	-	-	2	2	2	-	-	-
CO5	-	-	-	-	-	2	2	2	-	-	-

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP510</td><td colspan="4">Course Title: Management & Entrepreneurship</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW- 45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

Course objectives: The topic discusses the concepts of Management. It discusses the concepts of starting an organization, different types of companies. The main objective is to bring an awareness of various Principles of management like planning, organizing, staffing, controlling & leading followed by the industries. By this course, a student should diagnose a firm's competitive situation based on real world situations and implement entrepreneurial knowledge to overcome various short ranges and long range problems.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the meaning, nature, levels, characteristics of management	L1, L2	WK1 to WK4
CO2	Demonstrate types of planning, purpose of planning and taking decision under different conditions, the different organization structures with case examples.	L1, L2	WK1 to WK4
CO3	Apply the basic knowledge to demonstrate the various types of industrial ownerships for effective functioning of industries	L3	WK1 to WK6
CO4	Demonstrate the entrepreneurship process, its evolution and barriers in entrepreneurship.	L1, L2	WK1 to WK4,
CO5	Emphasis on small scale industries and various schemes supported by the government to start SSI	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Management:** Introduction -Meaning -nature and characteristics of Management, Scope and functional areas of Management - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- Early Management Approaches-Modern Management Approaches. *Self-Learning and Teamwork:* • Role of management as a Science, Art or Profession	09	-
2	**Planning**: Nature, importance and purpose of planning process – Objectives Types of plans, Decision making, Types of decisions, steps in decision making, steps in decision making, steps in planning and planning premises, Hierarchy of plans. **Organizing:** Nature and purpose of organization -Principles of organization Types of organization- Line, Functional, Line and Staff, committee and Matrix Organization, Departmentation, Committees- Principles, types, designing an Organizational structure, Centralization Vs Decentralization. *Self-Learning and Teamwork:* • *Strategy Vs Planning*. • *Case Studies on Types of Organization*	09	-
3	**Industrial Ownership:** Sole Proprietorship – Features, advantages and disadvantage, scope , Partnership – Characteristics, kinds of partners, partnership agreement or partnership deed, advantages and Disadvantages of partnership, Joint stock company- Features, formation, advantages and Disadvantages of a Joint Stock Company, Types of companies – chartered companies, statutory companies, registered companies, Holding and Subsidiary companies, Domestic and Foreign companies, Co-operative societies – Definition, Principles of Cooperative society, advantages and Disadvantages of Co-operative society. *Self-Learning and Teamwork:* *Case Studies* ➢ *Private Sector* ➢ *Public Sector*	09	-
4	**Entrepreneur:** Meaning and Evolution of the Concept, characteristics of Entrepreneur, Qualities of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Evolution of Entrepreneurship, Development of Entrepreneurship, stages in entrepreneurial process, Role of entrepreneurs in Economic Development; Entrepreneurship in India, Barriers of Entrepreneurship. *Self-Learning and Teamwork:* • *Project Proposal Preparation*	09	-
5	**Small scale industry:** Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI, Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., GATT/WTO, Supporting Agencies of Government for SSI. *Self-Learning and Teamwork:* • *Understanding the [Updated] New Government Policy and Supporting Agencies*	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Management and Entrepreneurship – Dr. N.V.R. Naidu
2. Hersey Paul and Kenneth H, —Management of Organizational Behaviour, PHI.
3. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill.
4. Entrepreneurship Development – Poornima. M. Charantimath, Small BusinessEnterprises – Pearson Education - 2006 (2 & 4).

Reference Books:

1. Management Fundamentals - Concepts, Application, Skill Development – Robers Lusier,Thomson.
2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi.
3. Koontz Odonnel, —Principles of Management, McGraw Hill Intl. Book Co.
4. Koontz Weirich, —Essentials of Management, TATA McGraw Hill Intl. Book Co
5. McGreggar Douglas, —The Human Side of Enterprise, McGraw Hill Intl. Book Co.

Web Resources:

1. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc22_ge03/preview
3. https://onlinecourses.nptel.ac.in/noc22_de08/preview

Course Articulation:

POs → COs ↓	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP520		*Course Title:* Design of Machine Elements				
Total Credits: 03 L- 30: T- 15: P-0 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PCC*	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	30		CIE	SEE	Total
	Tutorial	15	*Weightage %*	40	60	100
	Practical	-	*Maximum Marks*	40	60	100
	Self-Learning and Teamwork	45	*Minimum Marks*	20	25	45*
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Mechanics of Materials

Course Objective: This course will enable the students to:

1. Define the concept Static strength; Static loads and Failure of materials...
2. Understand the concept of spur and helical gear and stress, tension, and compression in springs.
3. Solve the problems on mechanical joints and rivets, welds.
4. Solve the problems on shaft sections under varying loads, etc.,
5. Solve the problems on Ball and Roller bearing.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the theories of failures and Determine the dimensions of mechanical components subjected to different types of static load.	L2,L3	WK1 to WK6
CO2	Analyze the machine elements subjected to fatigue and impact.	L3, L4	WK1 to WK6
CO3	Analyze mechanical joints and design welded and riveted joints for various loads.	L3, L4	WK1 to WK6
CO4	Design spur gear and different types of spring for different applications.	L3, L4	WK1 to WK6
CO5	Design the shaft for different load condition and analyze the mechanism of lubrication and compare design of bearing for different applications.	L3, L4	WK1 to WK6

L1– Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Design For Static Strength:** Design considerations: Codes and Standards, Static strength; Static loads and factor of safety; Theories of failure - Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Maximum strain theory. Stress concentration, Determination of Stress concentration factor. *Self-Learning and Teamwork:* • Failure of brittle materials, Failure of ductile materials	**06**	**03**
2	**Design For Fatigue Strength:** Introduction, S -N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors –size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Soderberg and Goodman, Stresses due to combined loading. *Self-Learning and Teamwork:* • Stress concentration effects – real world applications. • Application problems on Endurance limit	**06**	**03**
3	**Mechanical Joints:** Riveted Joints - Rivet materials, Failures of Riveted joints, Efficiency, riveted joint for boiler or pressure vessels. **Welded Joints -** Welds subjected axial loads, Eccentric loading - welds subjected to bending moment. *Self-Learning and Teamwork:* • Riveted Joints –Types • Welded Joints -Types, Strength of butt and fillet welds	**06**	**03**
4	**Design of Gears:** Introduction to Spur, Helical and bevel gears. Design of spur gears, stresses in gear tooth, Lewis equation, form factor, dynamic and wear load. **Design of Springs**: Types of springs -stresses in Helical Coil springs of circular and noncircular cross sections. Tension and compression springs. (Numerical examples). *Self-Learning and Teamwork: Types of gears* • *Practical applications of types of Springs*	**06**	**03**
5	**Design of Shafts:** Design for strength & rigidity, with steady loading, S codes for design of transmission shafting, Design of shafts under oads: Combined loads & Fluctuating loads. *Self-Learning and Teamwork:* • Application of Torsion of Shafts	**06**	**03**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Mechanical Engineering Design -Joseph Edward Shigley's, Tata McGraw Hill, New Delhi 2014.
2. Machine Design -.VL. Maleev and Hartman, CBS Publishers & Distribution, New Delhi, 2001.
3. Design Data Hand Book-K. Mahadevan and Balaveera Reddy, CBS Publication fourth edition, 2013

Reference Books:

1. Machine Design -Robert .L, Norton -Pearson Education Asia, New Delhi, 2014.
2. Design of Machine Elements -V. B. Bhandari, -Tata McGraw Hill Publishing Co. Ltd., New –Delhi, 2000.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3						3	2	1
CO2	3	3	3		3	3						3	2	1
CO3	3	3	3		3	3						3	2	1
CO4	3	3	3		3	3						3	2	1
CO5	3	3	3		3	3						3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP530		*Course Title:* Product design & Product life cycle Management				
Total Credits: 03 L- 30: T-15 : P-0 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PCC*	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	30		CIE	SEE	Total
	Tutorial	15	*Weightage %*	40	60	100
	Practical	-	*Maximum Marks*	40	60	100
	Self-Learning and Teamwork	45	*Minimum Marks*	20	25	45*
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -NIL-

COURSE OBJECTIVE:

1. The students will have the Competence with a set of tools and methods for product design and development & creating the Confidence to create a new product.
2. Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
3. Ability to coordinate multiple, interdisciplinary tasks to achieve a common objective.
4. Developing team working skills.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the concept of Design ideas, evolution of design & analyzing the need statement.	L1, L2, L3	WK1 to WK6
CO2	Explain the concept brainstorming, customer needs and to convert it into relevant product design.	L1, L2, L3	WK1 to WK6
CO3	Describe the different manufacturing processes used for manufacturing the products.	L1, L2	WK1 to WK4
CO4	Explain the concept testing of quality, ergonomic and reliability features.	L1, L2	WK1 to WK4
CO5	Demonstrate the human consideration in applying concepts in product design and development with emphasis on the assembly features.	L1, L2	WK1 TO WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Designing, distinction between Engineering and Design, Traditional Designer. Design by Evaluation, Morphology of Design, Analysis of need, need statement, Engineering design process and its structure, Product design specifications. Evaluation of Design concepts. Case studies. *Self-Learning and Teamwork:* • Customer Need Identification and Problem Definition	06	03
2	Generation of Concepts: preamble on creativity & its barriers, Innovation & Brainstorming, Preliminary product design, Product Planning, Resource allocation and Plan timing, Value Engineering: Introduction, Product life cycle, modularity. *Self-Learning and Teamwork:* • Generation of Concepts - Preliminary product design	06	03
3	Selection of Manufacturing Processes: Review of Manufacturing Processes, Design for Casting, Bulk Deformation Processes, Sheet Metal Forming Processes, metal machining, powder metallurgy, Welding, brazing, soldering, adhesive bonding, designing with Plastics, Rubber, Wood and other materials. *Self-Learning and Teamwork:* • Understanding the latest manufacturing Processes	06	03
4	Design for Reliability and Quality: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure. Economic Factor, Influencing for product Design: Design for Safety, and – Product life cycles. *Self-Learning and Teamwork:* • AI- approach to Product Design	06	03
5	Human Factors in Product Design: Product Design considerations in Ergonomics, Anthropometry; Man as occupant of Space, The Design of Controls, of controls, the Design of Displays, Man/Machine Information, Modern approaches to product Design. Product design for environment. *Self-Learning and Teamwork:* • Product Design considerations in Industries and study on Ergonomics	06	03

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for

SEE –SEMESTER END EXAMS

Text books:

1. Product Design and Manufacturing, A.C. Chitale and R.C. Gupta, PHI 6th edition.
2. Product Design & Development, Karl T. Ulrich & Steven D, Epinger, TataMc. GrawHill, 7th Edition.

Reference Books:

1. New Product Development, Tim Jones, Butterworh Heinmann, Oxford,mc.
2. New Product Development: Design & Analysis by Roland Engene Kinetovicz, John Wiley and Sosn Inc.,N.Y.

Web Resources:

1. https://nptel.ac.in/courses/112104230
2. https://nptel.ac.in/courses/112107258

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1		3	3						3	2	1
CO2	3	3	1		3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP540		*Course Title:* Industrial Engineering and Ergonomics				
Total Credits: 04 L- 45: T-0 : P-15 : SL and TW-60		SDGs addressed: 4,9 & 12			*Course Category: PCC*	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	40	60	100
	Practical	15	*Maximum Marks*	40	60	100
	Self-Learning and Teamwork	45	*Minimum Marks*	20	25	45*
	Total	105				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

1. To use various industrial engineering tools like charts, diagrams and ergonomics principles to conduct work study and work measurement techniques to conduct time study that will result in improvement of productivity and reduce stress to the worker.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Recollect the basic concepts of productivity, work content and work study and define the objective and scope of Work Study.	L1, L2	WK1 to WK4
CO2	Define the various charts and to construct the charts on the basis of the present method and develop a new / proposed method and identify the unnecessary movements.	L1, L2, L3	WK1 to WK6
CO3	Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time	L1, L2	WK1 to WK4
CO4	Determine the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.	L1, L2, L3	WK1 to WK6
CO5	Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Productivity:** Definition of productivity, measurement of productivity, single and multifactor productivity, productivity measurement models with simple problems. Causes of low productivity, productivity improvement techniques, case studies on productivity. **Work Study:** Definition, objective and scope of work study. Steps involved in work study. *Self-Learning and Teamwork:* • Factors affecting productivity • Concept of work content	09	-
2	**Method Study:** Definition, objective and scope of method study, steps involved in method study. **Recording Techniques:** Outline process charts, flow process charts, Multiple activity charts, Charts and diagrams to record movement at workplace - travel chart, flow diagram, and String diagram. Principles of motion economy, classification of movements, two handed process chart. *Self-Learning and Teamwork:* • Apply method study – to a given case example	09	-
3	**Work Measurement:** Definition, objectives and benefit of work measurement. Work measurement techniques. **Time study:** Definition, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, allowances and standard time determination with simple problems, work measurement applications **Work sampling** – need, confidence levels, sample size determinations, random observation, conducting study with simple problems. *Self-Learning and Teamwork:* • Work measurement applications – A concept in industry	09	-
4	**Ergonomics:** Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man machine systems and their functions - work capabilities of industrial workers, study of development of stress in the human body and their consequences. **Application of Ergonomics:** Case Study of Car Seat **AI Component:** HMI Optimization *Self-Learning and Teamwork:* • Man-Machine system from industry Point of View • Study of development of stress in the human body and their consequences.	09	-

5	**Design of Man-Machine System:** Fatigue in Industrial workers. Quantitative, qualitative representation and alphanumeric displays. Controls and their design criteria, control types, relation between controls and displays, layouts of panels and machines. **Design of workplace:** Influence of climate on human efficiency, influence of noise, vibration and light. *Self-Learning and Teamwork:* • Study of Fatigue in Industrial workers • Influence of noise, vibration and light on Performance of workers	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Integrated Lab

Course Content / Laboratory Syllabus:

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	To study the existing method of assembly of a component with the layout as given and a. Prepare the operation process chart. b. Prepare the two-handed process chart. c. Draw the learning curve. d. Determine the cycle time from the sufficient number of observations	-	-	03
2	For the operation in experiment no 1, Develop a new method, prepare improved new two handed process chart and calculate cycle time.	-	-	03
3	Experiments using the following charts/diagrams of Method Study: Outline process chart, Flow process chart, Flow diagram, String Diagram, Multiple activity chart, Two handed process charts.	-	-	03
4	Experiments on Time Study – Marble experiments, nut and bolt assembly, operating the mechanisms and other related case studies, Poke yoke concepts. Rating exercises.	-	-	03
5	Experiment on Ergonomics using Ergo meter and Tread mill- TMT test Determining the standard time and PMTS (Study & analysis)	-	-	03

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-15 hrs.] is only considered for CIE – INTERNAL ASSESSMENT /SEE –SEMESTER END EXAMS

Text Books:

1. Introduction to Work Study – ILO, Recent Edition
2. Barnes — Motion and Time Study. Wiley International **Reference Books:**
3. S. Dalela and Sourabh, —Work Study and Ergonomics
4. Kharger and Bahya; Engineered work measurement, Weldon, ELBS

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/112107249
2. https://nptel.ac.in/courses/112107142

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						2	2	2
CO2	3	3	1		3	3						2	2	2
CO3	3	3			3	3						2	2	2
CO4	3	3	1		3	3						2	2	2
CO5	3	3			3	3						2	2	2

High – 3, Medium – 2, Low – 1

INTEGRATED LAB:

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3						2	2	2
CO2	3	3	3		3	3						2	2	2
CO3	3	3	3		3	3						2	2	2
CO4	3	3	3		3	3						2	2	2
CO5	3	3	3		3	3						2	2	2

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP551		*Course Title:* Theory of Metal Forming				
Total Credits: 03 L- 45: T- 0: P-0 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PEC-1* [Professional Elective Course-1]	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	40	60	100
	Practical	-	*Maximum Marks*	40	60	100
	Self-Learning and Teamwork	45	*Minimum Marks*	20	25	45*
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre requisites: Elements of Mechanical Engineering

Course objectives: This course will enable students to:

1. To introduce the concept of different types of metal forming process
2. To introduce the concept of yield failure of criteria
3. To introduce the concept of explosive forming process
4. To make the student to known different types metal powders
5. To make the student to know the HERF methods.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the classification of metal forming & effects of parameters	L1, L2	WK1 to WK4
CO2	Illustrate the concept of forging and rolling process	L1, L2	WK1 to WK4
CO3	Expound the drawing equipment and sheet metal forming process	L1, L2,L3	WK1 to WK6
CO4	Design the Extrusion process and its types, defects and problem solving	L1, L2,L3	WK1 to WK6
CO5	Describe the HERF methods, types of explosives and powder metallurgy	L1, L2,L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction and Concepts:** Classification of metal working processes, advantages and limitations of metal working processes. Concepts of true stress, true strain, uniaxial, biaxial stresses & triaxial stresses with notation of state of stresses of different metal forming process, Determination of flow curve equation. concepts of principal plane and principal stresses Failure of yield theories, Tresca's &Von- Mises yield criteria, problems **Effects of Parameters:** Temperature, strain rate, Hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials *Self-Learning and Teamwork:* • Comparative study of all parameters Effects on workability of materi	09	--
2	**Forging:** Classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, Forging defects **Rolling:** Classification of Rolling processes. Expression for Rolling Load. Defects in rolled products. *Self-Learning and Teamwork:* • Industrial application of Forging and Rolling	09	--
3	**Drawing:** Drawing equipment & dies, expression for drawing load by slab analysis, power requirement, Tube drawing. **Sheet & Metal Forming:** Forming methods dies & punches, progressive die, compound die, combination die, Rubber forming. Open back inclinable press(OBI press) *Self-Learning and Teamwork:* • Applications of rubber forming	09	--
4	**Extrusion:** Introduction, extrusion equipment & defects in extrusion. Extrusion of seamless tubes. Extrusion variables and simple problems *Self-Learning and Teamwork:* • Types of extrusion processes	09	--
5	**High Energy Rate Forming:** Introduction, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming**.** **Powder Metallurgy:** Basic steps in Powder metallurgy brief description of methods of production of metal powders *Self-Learning and Teamwork:* • Applications of powder metallurgy.	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Mechanical metallurgy (SI units), G.E. Dieter, McGrawHill
2. Manufacturing Process – III, Dr. K. Radhakrishna, Sapna Book House

Reference Books:

1. Materials and Processes in Manufacturing, E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall of India
2. Principles of Industrial metal working process, G.W. Rowe, CBS pub.
3. Manufacturing Science, Amitabha Ghosh & A.K. Malik - East-West press
4. Technology of Metal Forming Process, Surendra kumar, PHI

Web Resources:

1. https://nptel.ac.in/courses/112107250
2. https://nptel.ac.in/courses/11213

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3	2		3	3						3	2	1
CO4	3	3	2		3	3						3	2	1
CO5	3	3	2		3	3						3	2	1

High – 3, Medium – 2, Low - 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP552</td><td colspan="5">Course Title: Non Destructive Testing</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PEC-1 [Professional Elective Course-1]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semeste</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre requisite: Nil

Course objectives: Students will get an insight on different non-destructive testing techniques and applications in various industries.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain selection of non-destructive methods and Common NDT Methods, Recent NDT Methods	L2	WK1 to WK4
CO2	Illustrate magnetic particle Inspection Methods and Eddy Current Inspection	L2	WK1 to WK4
CO3	Describe the Principle Operation of Ultrasonic Inspection and Practical Applications with Case study of Human Body	L2	WK1 to WK4
CO4	Explain Radiographic inspection its Principles and Practical applications with case Study on - X – ray of Human body	L2	WK1 to WK4
CO5	Illustrate industrial Computed Tomography and Case Studies of Eddy Current Inspection	L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Non-Destructive [ND] TESTING:** Selection of ND methods, Scope and advantages of NDT. Comparison of NDT with DT Some common NDT methods used since ages, Flaws and Defects Terminology. Common NDT Methods /Recent NDT Methods Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test *Self-Learning and Teamwork:* • Common NDT Methods /Recent NDT Methods	09	-
2	**Magnetic Particle Inspection:** Methods of generating magnetic fields – types of magnetic particles and suspension liquids – steps in inspection – application and limitations. Eddy Current Inspection: Principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications. *Self-Learning and Teamwork:* • Different methods to generate magnetic fields, Applications.	09	-
3	**Ultrasonic Inspection:** Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, Basic equipment characteristics of ultrasonic waves, variables in inspection, inspection methods – Pulse Echo A, B, C, scans, transmission, resonance techniques, transducer elements, couplets, search units, contact types and immersion types. CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultra Sonography of Human Body. *Self-Learning and Teamwork:* • Case Study – Ultra Sonography of Human Body	09	-
4	**Radiographic Inspection:** Principles, radiation sources, X-Rays and gamma rays: X - Rays tubes, radio graphic films, screens and filters, image intensifiers, technique charts, industrial radiography, electro-radiography, image quality, radiographic sensitivity, electron neutron radiography. X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of y-ray radiography – principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of Y-ray radiography over X-ray Radiography Precautions against radiation hazards.Case Study — X-ray of Human Body. *Self-Learning and Teamwork:* • Case Study — X-ray of Human Body	09	-

5	**Industrial Computed Tomography:** Basic principles, capabilities, and comparison with other NDE methods – application of ICT. Thermal inspection principles, equipment inspection methods applications. *Self-Learning and Teamwork:* • Industrial Computed Tomography -Equipment inspection methods applications.	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation. 2. Research Techniques in NDT Vol.3, R.S. Shah, Academic Reference Books:

1. Industrial Quality Control, Web star.
2. Bray, Don E .and Stanley, Roderick K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service, CRC Press New York.

Web/Digital resources:

1. https://www.wermac.org (Non Destructive Testing - Radiographic Testing (RT) – Wehrmacht)
2. https://www.twi-global.com (Radiography Testing - NDT Inspection - TWI Global)https://www.flyability.com (NDT (Non-Destructive Testing): A Complete Guide – Flyability)

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6		PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP553</td><td colspan="5">Course Title: Hydraulics and Pneumatics</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW- 45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PEC-1
[Professional Elective Course-1]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Prerequisite: Fluid Mechanics

Course objectives: This course will enable students to:

This course is essential in understanding the design, analysis, operation, maintenance, and applications of fluid power systems.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Illustrate the basic concept of fluid Mechanics to represent the structure of hydraulic system	L1,L2	WK1 to WK4
CO2	Explain the design of control components in Hydraulic System	L1,L2	WK1 to WK4
CO3	Demonstrate the Maintenance Schedule for Hydraulic System	L1,L2	WK1 to WK4
CO4	Explain the concept of Pneumatic System as per ISO 1219 & ISO 5599	L1,L2	WK1 to WK4
CO5	Illustrate the Multi cylinder Applications	L1,L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Hydraulic Power**: Pascal 's law and problems on Pascal 's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. *Self-Learning and Teamwork:* • Applications of Pascal's law	09	--
2	**Hydraulic Actuators and Motors**: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical Torque, power and flow rate, hydraulic motor performance. *Self-Learning and Teamwork:* • Principle of Hydraulic Actuators and Motors	09	--
3	**Maintenance of Hydraulic systems**: Hydraulic oils; Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting. Introduction to Pneumatic control: Choice of working Medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application. *Self-Learning and Teamwork:* • Importance of Maintenance of Hydraulic systems and Applications	09	-- --
4	**Directional Control valves**: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple **Pneumatic Control**: Direct and Indirect Actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders. *Self-Learning and Teamwork:* • ISO Standards [ISO 1219 and ISO 5599] its applications • Pneumatic Systems and Control	09	--

5	**Multi-cylinder applications**: Coordinated and sequential motion control. Motion an d control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro-Pneumatic control**: Principles-sign al input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. **Compressed air**: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air-Piping layout. *Self-Learning and Teamwork:* • Practical application examples on - Multi-cylinder applications	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Fluid Power with applications: Anthony Esposito, Fifth edition Pearson education, Inc.
2. Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co
3. Hydraulics & Pneumatics: Dr. H D Ramachandra, Sudha's student friendly text book series.

Reference Books:

1. Oil Hydraulic Systems: Principles and Maintenance, S.R. Majumdar, Tata McGraw Hill publishing company Ltd.
2. Pneumatic Systems: S.R. Majumdar, Tata McGraw Hill publishing Co.,

Web/Digital resources:

1. Introduction to hydraulics and pneumatics https://archive.nptel.ac.in
2. DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS https://mrcet.com › downloads › Design of Hydra...

Course Articulation:

POs → COs ↓		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		3	3			3	3					3	3	2	1
CO2		3	3			3	3					3	3	2	1
CO3		3	3			3	3					3	3	2	1
CO4		3	3			3	3					3	3	2	1
CO5		3	3			3	3					3	3	2	1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP554</td><td colspan="3">Course Title: Tool Engineering Design and Fixtures</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC-1
[Professional Elective Course-1]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre- requisites: Metal cutting and Machine tool

Course objectives: This course will enable students to:

1. To introduce the concept Tool design of shank
2. To introduce the concept of form tool, milling cutter & broaching tool design
3. To introduce the drill jigs and fixtures.
4. To establish the design of cutting tools and appropriate jigs & fixture from the industrial perspective

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Design the cutting tool shank its strength and rigidity	L3	WK1 TO WK6
CO2	Expound the milling cutter and problem solving	L3	WK1 TO WK6
CO3	Illustrate the broaching machine and Design of drills	L3	WK1 TO WK6
CO4	Explain the jigs and fixtures and its importance	L3	WK1 TO WK6
CO5	Describe the clamping devices and its types	L3	WK1 TO WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Cutting Tools:** Introduction, single point tools Tool nomenclature, tool signature Design of various cross section of shank of the single point cutting tool and its Strength and rigidity calculations. Problems *Self-Learning and Teamwork:* • Cutting Tool - Tool nomenclature	09	--
2	**Design of Milling Cutters:** Types, calculation, design details – design of profile sharpened milling cutter and form relieved milling cutter milling cutter calculations *Self-Learning and Teamwork:* • Design details - Design of Milling Cutters**,** Types	09	--
3	**Design of Broaches:** Introduction to broaching, types of broaching methods design elements of broaching Exercises on Broaches for the given job, Strength, and rigidity calculations **Design of Drills:** Design recommendation rules of drill holes and redesign of the component Taper shank, Straight Shank, Design of reamers, drilling, Strength and rigidity calculations Exercises *Self-Learning and Teamwork:* • Exercises on Broaches for the given job • Design details - Design of Drills	09	--
4	**Jigs & Fixtures:** Concept of jigs and Fixtures Introduction, principles of jigs & fixtures Tolerance analysis and procedure of designing. The economic calculations, location of the work piece, degree of freedom, references surfaces, resting components, fixture elements for surface concentric and radial locations *Self-Learning and Teamwork:* • Concept of jigs and Fixtures and Application [Case Study – Industry Concept]	09	--
5	**Clamping of the work piece:** Introduction to clamping devices & types of review of cutting forces, principles and methods *Self-Learning and Teamwork:* • Study on the various clamping devices	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Tool Engineering and Design, Nagpal G.R., Khanna Publishers, third edition, 2010
2. Metal Cutting and Design of Cutting Tools, Jigs & Fixtures , N.K.Mehta

Reference Books:

1. Metal Cutting and Tool design - Dr. B.J. Ranganath, Vikas Publishing house
2. Jigs & Fixtures- Grant Tool Design - C Donaldson- G.H. Le CAIN V.C Goold, TMH

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1
CO3	3	3	3		3	3					3	3	2	1
CO4	3	3	3		3	3					3	3	2	1
CO5	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP561</td><td colspan="5">Course Title: Engineering Economics</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PEC-2 [Professional Elective Course-2]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: -NIL-

Course Objective: To make the students to learn and understand the economic aspects like interest, Present Worth Comparisons, Taxation systems, Replacement analysis & Cost Accounting.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Explain the Engineering Decision Makers with analysis of Interest & Interest factors	L1, L2	WK1 TO WK4
CO2	Illustrate with numerical examples present worth comparisons with effects of taxation	L1, L2, L3	WK1 TO WK6
CO3	Illustrate with numerical examples equivalent annual worth comparisons with replacement analysis	L1, L2, L3	WK1 TO WK6
CO4	Illustrate with numerical examples Depreciation and Tax comparisons with tax considerations	L1, L2, L3	WK1 TO WK6
CO5	Illustrate with numerical examples Cost & cost accounting with suitable illustrative examples	L1, L2, L3	WK1 TO WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Unit No.	Course Content	Hours	
		Lecture	Tutorial
1	**Introduction**: Engineering Decision-Makers, Engineering and Economics, Demand & Supply. Agents of production, Labour & its characteristics. **Interest and Interest factors**: Interest rate, Simple interest, Compound interest, interest formulae, Cash – flow diagrams, Numerical xamples. *Self-Learning and Teamwork:* • Learn about demand and supply	09	----
2	**Present Worth Comparisons**: Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay-back comparison, Numerical examples. **Taxation**: Direct & Indirect cost, Characteristics of a good taxation system, examples. *Self-Learning and Teamwork:* • Conditions for present worth comparisons. • Goods and Service Tax	09	----
3	**Equivalent Annual Worth Comparisons**: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Numerical examples. **Replacement Analysis**: Basic reason for replacement, installation & removal costs, Common errors in replacement studies. Numerical examples. *Self-Learning and Teamwork:* • Comparison of assets with equal and unequal lives.	09	---
4	**Brief Discussion on Depreciation and Tax Considerations**: Nature of Depreciation, Causes of Depreciation, Basic methods of depreciation - Straight line, declining balance, sum of the year's digit method and sinking fund method. Numerical examples. *Self-Learning and Teamwork:* • Case study on causes of depreciation	09	----
5	**Cost & Cost Accounting**: First cost, fixed cost, variable cost, incremental cost, sunk cost and marginal cost. Break even analysis and minimum cost analysis. Direct Material Costs, Direct Labour manufacturing expenses, allocation of factory overheads. Examples *Self-Learning and Teamwork:* • Systematic set of procedures for recording and reporting of company's expenses.	09	---

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Riggs J.L., Engineering economy, McGraw Hill, 5th Edition
2. Thuesen H.G., Engineering economy, PHI, 4th Edition

Reference Books:

1. Tarachand, Engineering economy, 3rd Edition.
2. O P Khanna, Industrial Engineering and Management, Dhanpat Rai& Sons, 7th Edition 3. I M Panday , Financial Management , Vikas Publishing House, 9th Edition
4. Paul Deoarmo, Engineering economy, Macmillan Pub, Co, 6th Edition.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									3	3	2	1
CO2	3	3			2	2					3	3	2	1
CO3	3	3			2	2					3	3	2	1
CO4	3	3			2	2					3	3	2	1
CO5	3	3			2	2					3	3	2	1

0 -- No association, 1---Low association, 2--- Moderate association, 3---High association

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP562</td><td colspan="3">Course Title: Marketing Management</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PEC-2 [Professional Elective Course-2]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: Students will get an insight on importance of marketing and skills required to manage marketing.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Explain the concepts of Consumer markets and their behavior with its significance	L1, L2	WK1 TO WK4
CO2	Describe the impacts of Market Research & MIS in analyzing the data and arrive at suitable decisions.	L1, L2, L3,L4	WK1 TO WK6
CO3	Illustrate the Product life cycle and arrive at suitable decision making for its effective implementation with case examples.	L1, L2,L3	WK1 TO WK6
CO4	Sensitization of the effects in choosing right pricing and channels for Marketing of goods and services	L1, L2	WK1 TO WK4
CO5	Explain the roles and significance of Packaging, Branding and apply these with suitable case examples	L1, L2, L3	WK1 TO WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Market, Marketing and Marketing Management: Introduction:** Historical development marketing management, tasks and philosophies, modern marketing concepts, importance of marketing in the India Socio– economic system. Marketing System- Company marketing system – levels in marketing environment of a company, marketing process, marketing mix, and marketing strategy. **Consumer Markets and Buying Behavior:** Classification of consumer products, participants in the consumer buying decision, factors influencing consumer buying behaviour, characteristics influencing, Consumer behaviour, major stages in buying process. *Self-Learning and Teamwork:* • Online consumer behaviour	**09**	**-**
2	**Marketing Information Systems and Research:** Components of marketing information system. A sample case study towards establishing a Marketing information systems – benefits and uses marketing research system **Marketing Research**: Steps of marketing research, measurement of market demand. Types of Market Research, Feasibility study for a consumer product. *Self-Learning and Teamwork:* • Tools used in Marketing information systems	**09**	**-**
3	**Products Planning and Development:** The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of "New – product; major stages in new – product development product life cycle. *Self-Learning and Teamwork:* • Case study on product life cycle	**09**	**-**
4	**Pricing and Distribution:** Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions. Distribution channels **Marketing channels**: Functions, types of channels of distribution number of channel levels, Role of Digital Marketing, Practical aspects in using Social Media platforms. *Self-Learning and Teamwork:* • Case study on Pricing strategy • Social media marketing • Logistics	**09**	**-**

5	**Branding, Labeling, and Packaging:** Branding Reasons for branding, functions of branding features of types of brands, kinds of brand name. Labeling - Types, functions advantages and disadvantages, Packaging- Meaning, growth of packaging, function of packaging, kinds of packaging, Copy rights and Trade Marks, Patents. **Advertising and Sales Promotion:** Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media– kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion. *Self-Learning and Teamwork:* • Study on the consideration on the weightage of branding, labelling and packaging. • Basic principles of advertising and sales promotion	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Philip Koteler "Principles of Marketing", Prentice – Hall.
2. Philip Koteler "Marketing Management", Prentice – Hall.
3. Michael R Czinkota, Marketing Management, 2nd Edition, Vikas Publishing House, ISBN 981-240-366-3

Reference Books:

1. Wiliam J Stannon, "Fundamentals of Marketing", McGraw Hill
2. R.S.N. Pillia and Mrs. Bagavathi "Marketing" S. Chand & Co. Ltd
3. S.A Sherlaker, "Marketing Management"
4. Rajagopal, marketing Management Text & Cases, Vikas Publishing House, ISBN 81-259-0773-

Web Resources:

https://onlinecourses.nptel.ac.in/noc22_mg5

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3	1		3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP563</td><td colspan="3">Course Title: Six Sigma Methodology</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PEC-2 [Professional Elective Course-2]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: The students will be able to

1. Understand the process variation and its causes.
2. Observe the processes and identify the customer critical to quality requirements.
3. Analyse the data and identify the gap.
4. Develop the improvement strategies.
5. How the process is controlled and done in the future.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Explain the significance of Six Sigma methodology for the business organizations.	L1, L2	WK1 TO WK4
CO2	Describe the steps involved in the different phases of Six Sigma methodology.	L1, L2	WK1 TO WK4
CO3	Apply appropriate tools in the different phases of Six Sigma methodology.	L1, L2	WK1 TO WK4
CO4	Identify the deliverables of each phase of Six Sigma methodology and prepare check list.	L1, L2	WK1 TO WK4
CO5	Introduction to six sigma control phase and six sigma tools.	L1, L2,	WK1 TO WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Six Sigma and Define Phase:** **Introduction:** Process, Variation and its causes, SD, Defect, Spread of variation, Six Sigma, Six Sigma methodologies, Measuring process performance, Benefits of adapting Six Sigma, **Symptoms which indicate need for Six Sigma:** Customer concerns, Organizational concerns, understand the symptoms, Elements of Six Sigma **Six Sigma Process- Define Phase:** Define key customer, Define customer requirement, Define the problem, Define the core process, Define the goal, Define the projects, define phase deliverables, Check list for define phase. **Define Phase tools:** Customer requirement statement, SIPOC, Project plan. *Self-Learning and Teamwork:* • Basic principles, process, methods of six sigma • Six Sigma methodologies	9	-
2	**Six Sigma Process Measure Phase:** **Measure Process:** Observe the current process, Identify the customer CTQ, Prepare the CTQ Tree, Stratification, collect data, assess current performance level, calculate process capability, calculate current yield, calculate cost of quality, measure phase deliverables, project status review, check list for measure phase **Measure Phase Tools:** CTQ Tree, Detailed process map, Data collection planning sheet, data collection forms, process capability calculation, measurement system analysis, Gauge R&R Study . *Self-Learning and Teamwork:* • Data collection tools • Cost of quality	9	-
3	**Six Sigma Process- Analyze Phase:** **Analyse process:** Brain storm the data collected, Identify the gap, identify the special causes, list the possible special causes, identify the relationship, prioritise the special causes, verify and quantify the causes, prepare value stream map, review the revised process, trail run the revised process, finalise the action plan, analyse phase deliverables, project status review, check list for analyse phase. **Analyse phase tools: Common Tools:** Histogram, Box Plot, Control chart, Scatter chart, Cause and effect diagram, Pareto analysis, interrelations diagram. **Special Tools:** Regression Analysis, Hypothesis Testing, ANOVA, Multivariate analysis. *Self-Learning and Teamwork:* • Real world applications of analysis tools (common tools and special tools)	9	-

4	**Six Sigma Process- Improve Phase:** **Steps in improve Phase:** Screen the Potential causes, Prioritise the causes, Bainstorm and prioritise the possible solutions, check the suitability of the solution, finalise the improvement strategy, estimate savings, implement the solution in full, celebrate and reward team members, Deliverables, Project status review, Checklist for improve phase. **Improve phase tools:** Brain storming, Affinity diagram, Multi voting, Suitability Matrix, Linear Correlation and Regression Analysis, FMEA, DOE. *Self-Learning and Teamwork:* • Case study on project status review and check list.	**9**	**-**
5	**Six Sigma Process- Control Phase:** Control process: Planning, Documentation, Process control, Systems review, Prepare a tree Diagram, deliverables of the control phase, project status review, check list for control phase. **Six Sigma tools in control phase:** Related activity chart, Process Map, SOP, Control charts, TPM, Poka-Yoke, Management review and reporting. *Self-Learning and Teamwork:* • Study on best examples of - Control charts, TPM, Poka-Yoke	**9**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. N. Gopalakrishnan, Simplified Six Sigma – Methodology, Tools and Implementation, PHI, 2 12
2. Peter S. Pande et al., The Six Sigma Way Team Field Book: An Implementation Guide for Process Improvement Teams, McGraw- Hill, 1st Edition, 2 2

Reference Books:

1. Peter S. Pande et al., The Six Sigma Way: How GE, Motorola, and Other Top Companies are Honing Their Performance, McGraw- Hill, 1st Edition, 2 .
2. Mikel Harry and Richard Schroeder, Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations, Currency, 2 5

Web Resource: http://www.isixsigma.com/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

-- No association, 1---Low association, 2--- Moderate association, 3---High association

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP564</td><td colspan="5">Course Title: Statistics For Engineers</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC-2 [Professional Elective Course-2]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td colspan="2">SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td colspan="2">60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td colspan="2">60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td colspan="2" rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: The students will be able to

1. Explain the concepts related to data summarization, data handling and estimation techniques for
2. statistical processing.
3. Apply the concepts of probability, distributions and their applications to derive point and
4. interval estimates.
5. Analyze problems using descriptive and inferential statistical processing of data.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Describe and report data set using data analysis, presentation and interpretation techniques to understand various phenomena in the fields of science and engineering.	L1, L2	WK1 to WK4
CO2	Apply various statistical processing techniques to handle a set of data to estimate probabilities.	L1, L2, L3,L4	WK1 to WK6
CO3	Apply an appropriate statistical tool and analyze a specific set of data to estimate and draw conclusions about population parameters	L1, L2,L3	WK1 to WK6
CO4	Draw inferences about Linear Regression and Correlation data	L1, L2	WK1 to WK4
CO5	Draw inferences about population parameters and relations between variables based on analysis of sample data	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Data Summary and Presentation:** Data types, tabular and graphical displays: Stem and Leaf diagrams, Histograms, Box plots, Radar diagrams. **Concepts of Probability and Random Variables:** Sample spaces and Events, Interpretations of probability, Addition rules, Conditional probability, Multiplication and Total probability rules, Independence, Bayes Theorem. Random Variables, Discrete and continuous random variables. Probability distributions and mass functions, Numerical Problems *Self-Learning and Teamwork:* • Interpretation of graphical output from software packages such as an example Minitab	9	-
2	**Discrete Probability Distributions:** Discrete uniform, Binominal, Poisson, Geometric, Negative binomial, Hyper geometric distributions, Applications, Numerical Problems. **Continuous Probability Distributions:** Continuous uniform, Normal, Normal approximations, Exponential, Erlang, Gamma, Weibull distributions, Applications, Numerical Problems. *Self-Learning and Teamwork:* • Usage of software tools to demonstrate probability distributions	9	-
3	**Estimation Theory:** Statistical Inference, Random sampling, Properties of Estimators, Method of Moments, Sampling distribution, Central Limit Theorem, Sampling distribution of means and derived quantities, Numerical Problems. **Interval Estimation:** Confidence Intervals on mean (variance known and unknown), and variance of a Normal population. *Self-Learning and Teamwork:* • Method of Maximum Likelihood	9	-
4	**Simple Linear Regression and Correlation:** Empirical models, Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Common abuses of regression, Prediction of new observations, Correlation, Numerical Problems. *Self-Learning and Teamwork:* • Interpretation of graphical output from software packages such as Minitab	9	-
5	**Statistical Inference for a single sample:** Hypothesis testing, Inference on the mean of a Normal population (variance known and unknown), Inference on the variance of a Normal population, Testing for Goodness of Fit, Tests of association, Numerical Problems. *Self-Learning and Teamwork:* • Interpretation of graphical output from software packages such as an example Minitab	9	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Engineering Statistics, Douglas C. Montgomery, George C. Runger, Norma Faris Hubele, 5th Edition, 2 11, John Wiley & Sons, Inc., ISBN-13: 978- -47 -63147-8
2. Applied statistics and Probability for Engineers, Douglas C Montgomery, George C Runger, Wiley, 4th Edition, 2 7, Asia Student Edition, ISBN: 978-81-265-2315-3.
3. Statistics for Management, Richard I Levin, David S Rubin, 7th Edition, 1997, Prentice Hall India, ISBN: 978 13476292 .

Reference Books:

1. Probability and Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye, 8th Edition,
2. Pearson Education Inc., ISBN: 978-81-317-1552-9.
3. Softwares : Microsoft Excel / Minitab / Matlab / R

Online resources:

a) http://172.16.44.44/nnptel.html - choose NOC:Introduction to Data Analytics(Course sponsored by Aricent)

b) https://newonlinecourses.science.psu.edu/statprogram/undergraduate-studies
https://www.khanacademy.org/math/statistics-probability

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	1		3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP571OE</td><td colspan="5">Course Title: Lean Practices</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC II</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semeste</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
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<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVE: The objective is to appreciate the students with the background, applications and current status of lean manufacturing and to make them understand the relevant basic principles in this field.

COURSE OUTCOMES (COs): After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Illustrate the Lean revolution in Toyota, philosophy of the Toyota Production System and one point lesson	L1, L2	WK1 to WK4
CO2	Apply the different concepts of 5S, 3M, etc. to keep clean and standardizing the operation.	L1, L2, L3	WK1 to WK6
CO3	Analyze the concepts and implementation of just in time, Jidoka and poka-yoke systems.	L3, L4	WK1 to WK4
CO4	Explain the concept of Worker involvement and Systematic Planning Methodology, Kaizen circle activity, Practical Kaizen training with case examples	L1, L2	WK1 to WK4
CO5	Explain the concept of Hoshin Planning System and the culture of Lean production	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Craft production, mass production, the Ford system, Origin of lean production system, Lean revolution in Toyota, Systems and systems thinking, Basic image of lean production, Customer focus, Muda, One Point Lesson. *Self-Learning and Teamwork:* • Case study on MUDA and one point lesson	9	--
2	**Stability:** Standards in the lean system, Visual Management, Total Productive Maintenance, 5S system. **Standardized work:** Elements of standardized work, Charts to define standardized work, Man power reduction, Overall efficiency, standardized work and Kaizen, Common layouts. *Self-Learning and Teamwork:* • Case studies on 5S system	9	--
3	**Just in Time:** Introduction, Basic Principles of JIT, Kanban, Kanban rules, expanded role of conveyance, Production leveling, types of pull system, Value stream mapping. **JIDOKA:** Development of Jidoka concept, Poka-Yoke (mistake proofing) systems, Inspection systems and zone control –Types and use of Poka- Yoke systems, Implementing Jidoka. *Self-Learning and Teamwork:* • Case studies on KANBAN	9	--
4	**Worker involvement and Systematic Planning Methodology:** Worker Involvement – Activities to support involvement, Kaizen circle activity, Practical Kaizen training, Key factors for PKT success, Suggestion Programmes *Self-Learning and Teamwork:* • Case studies on KAIZEN	9	--
5	**Hoshin Planning System** (systematic planning methodology) – introduction, hoshin planning system, Four Phases of Hoshin Planning, the culture of Lean production. *Self-Learning and Teamwork:* • PDCA Cycle	9	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text books:

1. **Pascal Dennis, Lean Production Simplified**: A Plain-Language Guide to the World's Most Powerful Production System, Third Indian edition, CRC Press, 2 15.
2. **Toyota production system** –An integrated approach to just in time by Yasuhiro Monden – Engineering and Management press – Institute of Industrial Engineers Norcross Georgia 3rd edition 1998.

References:

1. **Lean and Agile Manufacturing**: Theoretical, Practical and Research Futurities, S.R. Devadasan, V.Mohan Sivakumar, R.Murugesh, P.R.Shalij, 2 12 edition.
2. Mike Rother and John Shook, Learning to See: **Value Stream Mapping to Add Value and Eliminate MUDA**, Lean Enterprise Institute, 1999.
3. **Japanese Manufacturing Techniques**. **The Nine Hidden Lessons by simplicity** by Richard Schourberger, 1982.
4. **"Just in Time Manufacturing**" , M. G. Korgaonker MacMillan. Reprinted 2 11
5. "**Lean thinking**" James P.Womack and Daniel T.Jones, 1996.

Web/Digital resources:

1.https://onlinecourses.nptel.ac.in/noc22_ce49/preview

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP572OE</td><td colspan="4">Course Title: Maintenance Engineering & Industrial Safety</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: OEC II</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Nil

COURSE OBJECTIVES: Understand the importance of industrial maintenance & safety in factory set-ups / other industries to improve the efficiency and productivity of the organization.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the importance of industrial maintenance & safety in factory set-ups / other industries to improve the efficiency and productivity of the organization.	L1, L2	WK1 to WK4
CO2	Discuss the various planning measures to be taken in effective maintenance of machinery	L1, L2, L3	WK1 to WK6
CO3	Critically analyze the pollution effects and to know the measures to be taken up in pollution control	L1, L2	WK1 to WK4
CO4	Explain the various safety precaution guidelines to be studied and implemented	L1, L2, L3	WK1 to WK6
CO5	Critically examine the accident prone situations and critically think the counter measures to be taken	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Maintenance System:** Definition, Scope, Objective, functions and Importance of maintenance system, Type of maintenance system, Break down maintenance system, Preventive maintenance, Predictive maintenance, design out maintenance, corrective maintenance, planned maintenance, total productive maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance. *Self-Learning and Teamwork:* • Type of maintenance system • Case studies on selection of methods like preventive or breakdown maintenance.	9	-
2	**Maintenance Planning:** Planning of maintenance junctures manpower allocation, Long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control. **Maintenance of Machinery:** Causes of machine failure, performance evaluation, complete overhauling of Machines tools. Maintenance planning and scheduling. Repair order control manpower requirement, Maintenance job analysis spare parts control. *Self-Learning and Teamwork:* • *Computer Aided* Maintenance control and Planning • Maintenance of Machinery **-** planning and scheduling	9	
3	**Industrial Pollution Control**: Dust control – Fibre collectors, mechanical dust collectors, wet type collectors, Electrostatic precipitators, Noise pollution Control– Noise Measurement and control. Industrial vibration and its control, applications of IPC. **Introduction to Industrial Safety and Management**: History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, Role of management and role of Govt. in industrial safety. *Self-Learning and Teamwork:* • Industrial Pollution Control **–** applications • Industrial Safety and Management - Govt. in industrial safety policy	9	-
4	**Accident Preventions and Protective Equipment** Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Firefighting equipment, Accident reporting, Investigations. Industrial psychology in accident prevention, Safety trials. *Self-Learning and Teamwork:* • Survey the plant for locations • Industrial psychology in accident prevention- Case Studies	9	-

5	**Economic importance of accidents**, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety Standards for Mechanical equipment. **Safety Standards**: Safety standards for Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, welding, Plant housekeepingbuilding, Aisles, passages, floors, tool cribs, washrooms, canteens. Industry case examples. *Self-Learning and Teamwork:* • Analysis of accident records • Plant housekeeping -Methods	**9**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Maintenance Engineering and Management - R.C.Mishra and K.Pathak, Prentice Hall of India.
2. Maintenance Engineering Hand book – Morrow, 3rd Edition.

Reference Books:

1. Hand book of Maintenance Management - Frank Herbaty.
2. Hand book of Industrial Engg & Management - W. Grant Lreson & Eugene L-Grant
3. Industrial Maintenance - H P Garg
4. Maintenance Engineering Hand book - Lindrey Higgins, McGraw Hill,
5. Plant Engineering Hand book – Staniar **Web Resources:**

1. https://nptel.ac.in/courses/11 1 5 94
2. https://nptel.ac.in/courses/1121 5 4

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	1		3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3	1		3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP573OE</td><td colspan="3">Course Title: Energy Engineering & Management</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC II</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: NIL

Course Objective: Understanding the various forms of conventional and non-conventional energy resources and its conversion to useful electrical energy.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the energy scenario, energy sources, energy storage and their utilization.	L1, L2	WK1 to WK4
CO2	Apply energy management and economic analysis to energy intensive Industries and buildings.	L1, L2, L3	WK1 to WK6
CO3	Explain the importance of environment and different types of eco system.	L1, L2	WK1 to WK4
CO4	Understand the implications of various types of environmental pollution.	L1, L2	WK1 to WK4
CO5	Expound the social issues, environment acts and issues involved in enforcement of environmental legislation.	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Power plants**: classification of power plants, Selection criteria for suitable site for power stations, Selection of power plant equipment, Economics in plant selection Power plant Performance: performance and operating characteristics of power plants, types of loads, numerical examples on load curve and load duration curve. *Self-Learning and Teamwork:* Different terms and definitions related to loads, load curves, load duration curves	**09**	**-**
2	**Steam Power Plant**: General layout of steam power plants and essential components, Different Types of Fuels used for steam generation, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling systems. *Self-Learning and Teamwork:* Equipment for burning coal in lump form, different types strokers, Oil burners	**09**	
3	**Hydro-Electric Power Plants**: General layout of hydel power plants with its essential components, Plant selection criteria, Classification of Hydroelectric power plants, numerical examples on - flow duration and mass curves. **Nuclear Power Plant**: Criteria for nuclear plant site selection, Elements of the nuclear reactor. Selection of materials for reactor components, Brief description of principle and working of reactors of the following Types-Pressurized water reactor, Sodium graphite reactor, Fast Breeder reactor. *Self-Learning and Teamwork:* • Classification and selection of hydraulic turbines • Safety measures for nuclear power plants, Radiation hazards, Shielding, Radio-active waste disposal.	**09**	**-**
4	**Solar Energy**: Solar radiation measuring instruments, Collectors in various ranges and applications – Flat plate collectors and Focusing type collectors, Solar pond technology, Low temperature thermal power generation using solar energy, Medium temperature systems using focusing collectors, High temperature systems. **Wind Energy**: Terms and definitions associated with wind energy, Properties of wind, availability and measurement of wind energy, wind velocity and power from wind, major problems associated with wind power, Types of wind machines – horizontal and vertical axis wind mills, *Self-Learning and Teamwork:* • Basics of solar energy and wind energy generation. • Considerations for selection of site for wind energy conversion systems.	**09**	**-**
5	**Tidal Power**: Tides and waves as energy suppliers and their mechanics; harnessing tidal energy, limitations. **Ocean Thermal Energy Conversion**: Open and Rankin cycle, problems associated with OTEC. **Geothermal Energy Conversion**: Types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy. *Self-Learning and Teamwork:* • Fundamental characteristics of tidal power • Principle of working - OTEC and Geothermal energy conversion	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Power Plant Engineering, R. K. Rajput, Laxmi publication, New Delhi, 5th Edition
2. Power Plant Engineering, Domakundawar, Dhanpath Rai sons. 2 3.

Reference Books:

1. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill, Fifth Edition
2. Non-conventional Energy sources, G D Rai Khanna Publishers. 2 14

Web Resources:

1. https://nptel.ac.in/courses/1 81 5 58
2. https://nptel.ac.in/courses/1 31 32 6

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	1		3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP574 OE</td><td colspan="4">Course Title: Engineering Economics</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC II</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: -NIL-

Course Objective: To make the students to learn and understand the economic aspects like interest, Present Worth Comparisons, Taxation systems, Replacement analysis & Cost Accounting.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the Engineering Decision Makers with analysis of Interest & Interest factors	L1, L2	WK1 to WK4
CO2	Illustrate with numerical examples present worth comparisons with effects of taxation	L1, L2, L3	WK1 to WK6
CO3	Illustrate with numerical examples equivalent annual worth comparisons with replacement analysis	L1, L2, L3	WK1 to WK6
CO4	Illustrate with numerical examples Depreciation and Tax comparisons with tax considerations	L1, L2, L3	WK1 to WK6
CO5	Illustrate with numerical examples Cost & cost accounting with suitable illustrative examples	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Unit No.	Course Content	No. of Hours	Tutorial
1	**Introduction**: Engineering Decision-Makers, Engineering and Economics, Demand & Supply. Agents of production, Labour & its characteristics. **Interest and Interest factors**: Interest rate, Simple interest Compound interest, interest formulae, Cash – flow diagrams, Numerical examples. *Self-Learning and Teamwork:* •Study on Effects of compound interest.	09	-
2	**Present Worth Comparisons**: Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay-back comparison, Numerical examples. **Taxation**: Direct & Indirect cost, Numerical examples. *Self-Learning and Teamwork:* •Characteristics of a good taxation system.	09	-
3	**Equivalent Annual Worth Comparisons**: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Numerical examples. **Replacement Analysis**: Basic reason for replacement, installation & removal costs. Numerical examples. *Self-Learning and Teamwork:* • Consideration of asset life • Common errors in replacement studies	09	-
4	**Brief Discussion on Depreciation and Tax Considerations**: Causes of Depreciation, Basic methods of depreciation -Straight line, declining balance, sum of the year's digit method and sinking fund method. Numerical examples. *Self-Learning and Teamwork:* •Nature and characteristics of depreciation and its importance	09	-
5	**Cost & Cost Accounting**: First cost, fixed cost, variable cost, incremental cost, sunk cost and marginal cost. Break even analysis and minimum cost analysis. Direct Labour manufacturing expenses, allocation of factory overheads. Examples *Self-Learning and Teamwork:* Direct Material Costs	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Riggs J.L., Engineering economy, McGraw Hill, 5th Edition
2. Thuesen H.G., Engineering economy, PHI, 4th Edition

Reference Books:

1. Tarachand, Engineering economy, 3rd Edition.
2. O P Khanna, Industrial Engineering and Management, Dhanpat Rai& Sons, 7th Edition 3.
3. I M Panday , Financial Management , Vikas Publishing House, 9th Edition
4. Paul Deoarmo, Engineering economy, Macmillan Pub, Co, 6th Edition

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	2		3	3						3	2	1
CO3	3	3	2		3	3						3	2	1
CO4	3	3	2		3	3						3	2	1
CO5	3	3	2		3	3						3	2	1

0 -- No association, 1---Low association, 2--- Moderate association, 3---High association

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP58L</td><td colspan="5">Course Title: Computer Aided Engineering Analysis Lab</td></tr>
<tr><td colspan="2">Total Credits: 1.5
L- 0: T- : P-45 : SL and TW-0</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category: PCCL</td><td>Course Type: Laboratory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>-</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>45</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>-</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>45</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Computer Aided Drawing / Engineering Graphics

COURSE OBJECTIVES:

Students will learn the concepts of Finite Elements Analysis using ANSYS /FEAST software.
Students will perform structural, thermal analysis and fluid-flow analysis.

COURSE OUTCOMES (COs): After completing this course, students should be able to do:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Linear and dynamic analysis of 1D, 2D & 3D problems of the given component involving evaluation of displacement and different types of stresses.	L1, L2, L3	WK1 to WK6
CO2	Analysis of the given component for thermal & fluid flow analysis involving heat transfer and potential distribution.	L1, L2, L3	WK1 to WK6

Course Content / Syllabus:

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	**a. Finite Element Analysis of Axially Loaded Members** • Bars of Constant Cross-Section Area • Bars of Varying Cross-Section Area • Stepped Bar **b. Finite Element Analysis of Trusses** • Minimum 3 Examples **c. Finite Element Analysis of Beams** • Simply Supported Beams • Cantilever Beams **d. Stress Analysis of a Rectangular Plate with a Circular hole** • Minimum 2 Examples **e. Axis-Symmetric Solids**	-	-	30
	• Minimum 2 Examples **f. Dynamic Analysis** • Fixed beam for natural frequency determination • Transverse Vibrations of a Cantilever beam Axial Vibration of a bar			
2	**I. Thermal Analysis** - One-dimensional Heat Conduction - Two-dimensional problem with conduction and convection boundary conditions **II. Fluid Flow Analysis** - Potential Distribution in 2D bodies	-	-	15

Text Book / Tutorials:

1. ANSYS for Designers by Professor Sham Tickoo, CADCIM Technologies, USA
2. A Primer on Finite Element Analysis, Anand V Kulakarni, Ventakesh K Havanur, Laxmi Publishers, First edition, 2 11. 3. University of Alberta ANSYS tutorials

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

DEPARTMENT OF HUMANITIES SCHEME & SYLLABUS

Fifth/Sixth semester

(From the Academic Year 2024-25)

<table>
<tr><td colspan="8">DEPARTMENT: HUMANITIES</td></tr>
<tr><td colspan="2">Course Code:
24HU510 / 24HU610</td><td colspan="6">Course Title CONSTITUTION OF INDIA & PROFESSIONAL ETHICS</td></tr>
<tr><td colspan="2">Total Credits: 00
L-15: T-0: P-0: SL and TW-15</td><td colspan="3">SDGs addressed: 1-17</td><td colspan="2">Course Category: HSMC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact Hours/semester</td><td colspan="5">Assessment Weightage and Marks</td></tr>
<tr><td>Lecture</td><td>15</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage, %</td><td>100%</td><td>-</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>-</td><td>40</td></tr>
<tr><td>Self-learning and Termwork</td><td>15</td><td rowspan="2">MinimumMarks</td><td rowspan="2">20</td><td rowspan="2">-</td><td rowspan="2">20</td></tr>
<tr><td>Total</td><td>30</td></tr>
</table>

Note: *For passing the student must score a Minimum of Marks 20 (CIE)

COURSE PRE-REQUISITE: NIL

COURSE OBJECTIVE:

1. To provide basic information about Indian Constitution.

2. To identify individual role and ethical responsibility towards society.

COURSE OUTCOMES (COs):By the end of the course, students will be able to:

CO	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Have general knowledge and legal literacy and thereby to tale up competitive examinations.	L2	WK1
CO2	Remember their Fundamental Rights, DPSP‟s and Fundamental Duties (FD‟s) of our constitution	L2	WK 7
CO3	Know about our Union Government, political structure & codes, procedures.	L3	WK 8
CO4	Understand our State Executive & Elections system of India. Remember the Amendments and Emergency Provisions, other important provisions given by the constitution.	L2	WK8
CO5	Know importance of professional ethical values.	L2	WK 8,9

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Syllabus:

Unit No.	Content	Lecture Hours
1	**Introduction and meaning** Introduction to the constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitutional Fundamental Rights & its limitations. **Self-Learning and Termwork** Reading and note making Draw a flow chart of Preamble with its keywords Group Discussion on Making of Constitution. Writs table with real legal remedies	**06**
2	**Fundamental Duties and DPSP, Union executive** Directive principles of State Policy & Relevance of Directive principles of State Policy Fundamental Duties. Union Executives – President, Prime Minister, Parliament, Supreme Court of India. **Self-Learning and Termwork** Article index preparation Case law study Apply concepts to real life scenarios.	**06**
3	**State Government, Judiciary and Election Process** State Executives – Governor, Chief Minister, State Legislature, High Court of State. Electoral Process of India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th, and 91st Amendments. **Self-Learning and Termwork** Structure Diagram by memorizing hierarchy of Union, State and local bodies Amendment tracking Mock Parliament. Visit to Law Courts.	**06**
4	**Social Provision, Emergency Provisions** Social Provision for SC & ST Special Provision for Women, Children and Backward Classes, Emergency Provisions. Powers and Functions of Municipalities, Panchayats and Co-operative Societies. **Self-Learning and Termwork** Article and Land mark case analysis Case study and discussion on Emergency provisions Poster/Infographic making Build a comparative Panchayat vs. Municipality table Visit/state portal or verified news to find scheme per group	**06**
5	**Professional Ethics** Scope and Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risk, Safety and liability of Engineers, Honesty, Integrity and Reliability in Engineers. **Self-Learning and Termwork** Case Study Review: Analyze Bhopal Gas Tragedy, Challenger Disaster, Chernobyl. Reflect on responsibility, risk, and honesty.	**06**

	Code of Ethics Comparison: Compare IEEE, NSPE, and Institution of Engineers (India) codes. Ethics Diary: Maintain a weekly journal on ethical dilemmas encountered in technology/news. Poster making on list of Professional Ethics identify ethical concerns at various work places	

Text Books:

- V.N. Shukla – Constitution of India
- M.P. Jain – „Indian Constitutional Law"
- "Constitution of India" (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022.
- "Engineering Ethics", M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice – Hall, 2004.
- R. S. Naagarazan - Professional Ethics and Human Values"

Reference Books

- M. Laxmikanth- Indian Polity
- D.D. Basu- Introduction to the Constitution of India.
- F.C. Strong – Federalism
- V.D. Mahajan – Modern Government
- D.D. Basu – Shorter Indian Constitutional Law
- Dr. Subhash C. Kashyap – The Framing of India"s Constitution
- Caroline Whitbeck- Ethics and the Practice of Engineering.

Journals/Magazines:

- Indian Journal of Constitutional Law (IJCL)
- Yojana (by Government of India) – Monthly magazine with simple explanations of government policies and constitutional aspects.
- Journal of Engineering Education **(ASEE).**
- IEEE Technology and Society Magazine**.**

Web/Digital resources:

- The Ministry of Law & Justice (GoI) structured video series https://legalaffairs.gov.in
- "Samvidhaan: The Making of the Constitution of India", https://www.youtube.com/playlist
- Indian Constitution: https://www.youtube.com/watch
- https://www.ijlsi.com/15-separation-of-powers-a-comparative-study-under-india-uk- and-usa-constitution/
- https://www.insightsonindia.com/polity/indian-constitution/salient-features-of-

indian constitution/

- https://www.clearias.com/constitution-of-india/
- National Board of Accreditation (NBA) India – outcome-based education resources on ethics.
- AICTE Student Handbook on Professional Ethics
- IEEE Code of Ethics: https://www.ieee.org/about/corporate/governance/ethics.html

SWAYAM/NPTEL:

- Constitutional Government & Democracy in India, Prof. Amitabha Ray (St. Xavier‟s College, Kolkata) https://onlinecourses.swayam2.ac.in/cec21_hs35/preview
- Constitutional Studies, Prof. Sudhir Krishnaswamy (NLSIU) https://onlinecourses.swayam2.ac.in/cec24_lw17/preview .
- Constitutional Law & Public Administration in India, Prof. Sairam Bhat (NLSIU) https://onlinecourses.nptel.ac.in/noc24_lw05/preview
- "Ethics in Engineering Practice" – IIT Madras (NPTEL). https://onlinecourses.nptel.ac.in/noc21_mg60/preview
- Moral Thinking: An Introduction to Values and Ethics- (IIT Kanpur / NPTEL) https://nptel.ac.in/courses https://archive.nptel.ac.in

Course Articulation Matrix:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	2	-	-	-	2
CO2	-	-	-	-	-	1	2	-	-	-	2
CO3	-	-	-	-	-	1	2	-	-	-	2
CO4	-	-	-	-	-	1	2	-	-	-	2
CO5	-	-	-	-	-	1	2	-	-	-	2

High – 3, Medium – 2, Low – 1

Evaluation Scheme:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted
CIE – 1	Written Test – 1	15
CIE – 2	Event	10
CIE – 3	Written Test – 2	15

Note:

1. The written test 1 & 2 (CIE – 1 & 3) both will be conducted for 15 marks each in 1 hour duration.
2. The Event (CIE – 2) will be conducted for 10 marks.
3. The Event (CIE – 2) will be skill-based assessment such as Seminars / Technical talks / Case study / hands-on activity / Mini projects / Sci-tech activity / Data analysis.
4. A student must score on an average of 50% i.e., 20 marks out of 40 from all the events (CIE - 1, 2, 3) to gain the eligibility to appear for SEE.
5. The eligibility marks are 20.

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP610</td><td colspan="5">Course Title: Operations Research</td></tr>
<tr><td colspan="2">Total Credits: 04
L- 45: T- 0: P-15 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>15</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>60</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>120</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

1 To enable the students to understand the scientific methods of providing various departments of an organization with a quantitative basis of decision making and to enable the students to understand the importance of various tools and techniques in finding optimal solutions to problems involving limited resources in the form of Men, Materials and machinery.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Formulate real life problems as Linear programming problems and solve using graphical method.	L1, L2, L3	WK1 to WK6
CO2	Derive optimal solutions to linear programming problems by Simplex and Big-M methods and understand primal and dual concepts to solve problems.	L1, L2, L3	WK1 to WK6
CO3	Understand and apply transportation, Assignment and travelling salesman concepts to solve real life problems.	L1, L2, L3	WK1 to WK6
CO4	Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks, Apply game theory and queuing theory methods to solve real life problems.	L1, L2, L3	WK1 to WK6
CO5	To implement practical cases of Operations Research (Using modern tools)	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Definition of OR, OR Phases, Features and Limitation of OR, Application of OR to Engineering and Managerial problems. **Linear Programming:** Definition, mathematical formulation and Graphical solutions. *Self-Learning and Teamwork:* • Interdisciplinary approach to OR.	**09**	
2	**Simplex methods:** Canonical and standard form of LPP, slack, surplus and artificial variables, solution using Simplex and Big M methods – feasible, basic feasible, optimal, infeasible, multiple optimal solutions. *Self-Learning and Teamwork:* • To study real world examples using Simplex and Big M methods	**09**	
3	**Transportation Problem:** Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem. Degeneracy in transportation problems: Concept of Degeneracy and its application in Transportation problems. **Assignment Problems:** Formulation and unbalanced assignment problem. **AI Content**: AI/ML can analyze real-time traffic data and optimize delivery routes, while OR techniques can be used to minimize transportation costs and delivery times. *Self-Learning and Teamwork:* • To study real world examples using transportation and assignment method	**09**	
4	**Project Management Using Network Analysis:** Overview of Project Management fundamentals, Network construction. CPM - Determination of critical path and duration, floats. Flow in networks: Determination of shortest route, PERT- Estimation of project duration, types of estimation and calculation of variance. Concept of Crashing. *Self-Learning and Teamwork:* • To study real world examples using CPM and PERT	**09**	
5	**Queuing Theory:** Queuing system and their characteristics. Kendall's notation, Steady state performance of M/M/1 queuing model. **Game Theory:** Formulation of games, Two person–Zero sum game, games with and without saddle point, Graphical solution (2xn, mx2 game) and dominance property. *Self-Learning and Teamwork:* • To study real world examples using queuing theory and game theory	**09**	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-60 hrs] is only considered for CIE – INTERNAL ASSESSMEN not for SEE –SEMESTER END EXAMS

Course Content / Syllabus(Laboratory)

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	Study and analysis of the following methods of Operation Research using Operations Research Software ➢ Linear Programming Models.	-	-	5
2	Study and analysis of the following methods of Operation Research using Operations Research Software ➢ Transportation Models. ➢ Assignment Models.	-	-	5
3	Study and analysis of the following methods of Operation Research using Operations Research Software ➢ Queuing Models. ➢ Game Theory	-	-	5

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-15 hrs] is only considered for CIE – INTERNAL ASSESSMENT /SEE –SEMESTER END EXAMS

Text Books:

1. Taha H A - Operation Research: An Introduction, Pearson; 10th edition.
2. Philips, Ravindran and Solberg-Operations Research: Principles and Practice, Wiley; 2nd edition

Reference Books:

1. Hiller and Liberman, Introduction to Operation Research, McGraw Hill 5thedn.
2. S.D. Sharma – Operations Research, Kedarnath, Ramnath & Co.
3. J K Sharma, Operations Research Theory and Application, 2nd Edn.
4. Kanthi Swarup & Others – Operations Research., Sulthan chand and Sons

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/110106062
2. https://nptel.ac.in/courses/11110712

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1
CO3	3	3	3		3	3					3	3	2	1
CO4	3	3	3		3	3					3	3	2	1
CO5	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

INTEGRATED LAB

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	2
CO2	3	3	3		3	3					3	3	2	2
CO3	3	3	3		3	3					3	3	2	2
CO4	3	3	3		3	3					3	3	2	2
CO5	3	3	3		3	3					3	3	2	2

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP620</td><td colspan="5">Course Title: Computer Aided Design and Manufacturing</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

To understand the role of computers in design, manufacturing and in product life cycle, basic hardware structure, understand configuration of graphics system, geometric modelling, concept of assembly design, modelling of exchange data and role of computers in process planning and inspection.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the role of computers in design, manufacturing product life cycle, usage of hardware in computers.	L1, L2	WK1 to WK4
CO2	Illustrate software configuration of graphics system, geometric modelling, and solid modelling techniques.	L1, L2, L3	WK1 to WK6
CO3	Explain different surface modelling techniques and modelling of exchange of data.	L1, L2,L3	WK1 to WK6
CO4	Explain the use of different computer applications in manufacturing, and able to prepare part programs for simple jobs on CNC machine tools	L1, L2, L3	WK1 to WK6
CO5	Explain the concept of Automation, CIM, CAD, CAM and explain the differences between these concepts.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Implementing a CAD/CAM System: Introduction, Turnkey CAD/CAM Systems, Disadvantages of In house CAD/CAM development, extending Turnkey CAD/CAM System, Selection Criteria, Evaluation of alternative Systems. Self-Learning and Teamwork: • A survey of commercial Turnkeys CAD CAM systems	09	
2	Flexible Manufacturing: Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, *Self-Learning and Teamwork:* • FMS benefits and applications	09	
3	Computer process control: Introduction, structural model of manufacturing process, process control strategies, distributed control vs central control, direct digital control *Self-Learning and Teamwork:* • Supervisory computer control	09	
4	**Introduction to CNC**: components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations. **Introduction to Robotics**: Introduction, robot configuration, robot motion, programming of robots, end effectors work cell, control and interlock, robot sensor, robot applications *Self-Learning and Teamwork:* • Exercises on CNC programming • Understanding the G Codes, M Codes - Sequence	09	
5	**Introduction to CIM and Automation:** Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. *Self-Learning and Teamwork:* • Applications of CIM	09	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. CAD/CAM principles and applications by P N Rao
2. CAD/CAM by Groover.

Reference Books:

1. Introduction to design & analysis of algorithms - S.E.Goodman, S.T.Headetmiemi
2. Principles of interactive computer graphics by Newman & Sproul
3. Computer graphics by Steven Harrington
4. CAD-CAM by ChrisMcMahon & JimmieBrowne
5. CAD-CAM by IbrahimZeid

Web resources:

1. https://nptel.ac.in/courses/112/104/1121040

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP630</td><td colspan="5">Course Title: Quality Engineering</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -NIL-

COURSE OBJECTIVE:

To make an impression upon students in the learning the various Quality philosophies and quality tools to improve the organization's/Industry performance and customer satisfaction. The students learn about the basic concepts of quality assurance and statistical process control charts.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	**Highest Level of Cognitive Domain**	**Working Knowledge**
CO1	Explain the concept of Quality, quality costs, Importance, and benefits of quality control.	L1, L2	WK1 to WK4
CO2	Explain the fundamental basics & significance of quality control in organization & enlighten the different Quality philosophy and management strategies, importance of Reliability, Audit and other basic responsibility of quality engineer.	L1, L2	WK1 to WK4
CO3	Describe the differences between attributes and variables data, basic principle of distribution curve and its importance. Causes of variations in quality.	L1, L2	WK1 to WK4
CO4	Illustrate the control chart techniques to find out the calculate standard deviation, mean for Variable data set for continuous quality improvement.	L1, L2, L3	WK1 to WK6
CO5	Illustrate the control chart techniques to find out the calculate standard deviation, mean for Attribute data set for continuous quality improvement.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, statistical methods for quality improvement, Quality costs – four categories' costs and hidden costs. Introduction to Quality function deployment. *Self Learning and Team work:* • Failure mode effect analysis(FMEA)	09	
2	Quality philosophy and management strategies, Introduction to Quality Function Deployment. Quality audit concept, audit approach etc., structuring the audit program, planning and performing audit activities, audit reporting, and ingredients of a quality audit program, Inspection planning, responsibilities of quality manager. Reliability, ISO standards and applications. *Self Learning and Team work:* • Redundancy effect.	09	
3	Basic statistical concepts: Introduction to concept of variation – Chance and Assignable causes of variation. Data collection, Probability distributions- Poisson and Normal distribution. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational sub groups. Statistical process control, Analysis of patterns of control charts. Case studies on application of SPC Basic definitions, standardized formula, Six- Sigma concept. **AI component**: Process optimization: AI can identify bottlenecks and inefficiencies in a process, allowing for adjustments to optimize performance and improve product quality. *Self Learning and Team work:* • *Design for Six Sigma(DFSS)*	09	
4	Control Charts for variables: The Frequency distribution and Histogram. Control charts for X-bar and Range(R), statistical basis of the charts, development and use of X-bar and R charts, interpretation of charts. To calculate standard deviation, mean & Process capability. *Self Learning and Team work:* • Application of X-bar and S charts	09	
5	Control Charts for Attributes: Control chart for fraction non-conforming (defectives) - development and operation of control chart, brief discussion on variable sample size. Control chart for non-conformities (defects). Choice between variables and attributes control charts. Guidelines for implementing control charts. *Self Learning and Team work:* • Understanding the features of control charts Software. [Example- MINITAB]	09	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Statistical Quality Control, .M Mahajan, Dhanpat Rai & Co.(P) Ltd, 2006 and later editions.
2. Introduction to Statistical Quality Control : D.C. Montgomery, John Wiley and Sons.
3. Introduction to statistical Quality Control- DC Montgomery, John Wiley and Sons, 7 th edition ISBN : 978-1-118-32416-5

Reference Books:

1. Fundamentals of Quality Control & Improvement by Amitava Mitra (Auburn University,
2. USA), Wiley publication 2008.
3. Quality Planning and Analysis: J.M. Juran and FrankM. Gryna, TATA McGraw-Hill 4. Quality : Grant and Leavenworth, McGraw-Hill.

5. JanetL. Novack and Kathleen C. Bosheers, —TheQS9000 Documentation Tool kit Prentice Hall PTR. Company Ltd, RamNagar, New Delhi.

Web Resources:

1. https://nptel.ac.in/courses/110105088

E-BOOKS

2. http://bookboon.com/en/quality-management-ebook

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP640</td><td colspan="5">Course Title: Lean Manufacturing</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- : P-15 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVE: The objective is to appreciate the students with the background, applications and current status of lean manufacturing and to make them understand the relevant basic principles in this field.

COURSE OUTCOMES (COs): After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Illustrate the Lean revolution in Toyota, philosophy of the Toyota Production System and one point lesson	L1, L2	WK1 to WK4
CO2	Apply the different concepts of 5S, 3M, etc. to keep clean and standardizing the operation.	L1, L2, L3	WK1 to WK6
CO3	Analyze the concepts and implementation of just in time, Jidoka and poka-yoke systems.	L1, L2, L3	WK1 to WK6
CO4	Explain the concept of Worker involvement and Systematic Planning Methodology, Kaizen circle activity, Practical Kaizen training with case examples	L1, L2	WK1 to WK4
CO5	Explain the concept of Hoshin Planning System and the culture of Lean production	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Craft production, mass production, the Ford system, Origin of lean production system, Lean revolution in Toyota, Systems and systems thinking, Basic image of lean production, Customer focus, Muda, One Point Lesson. *Self-Learning and Teamwork:* • Lean revolution in industries.	09	--
2	**Stability:** Standards in the lean system, Visual Management, 5S system, Total Productive Maintenance. **Standardized work:** Elements of standardized work, Charts to define standardized work, Man power reduction, Overall efficiency, standardized work and Kaizen, Common layouts. *Self-Learning and Teamwork:* • Case studies on Total Productive Maintenance(TPM).	09	--
3	**Just In Time:** Introduction, Basic Principles of JIT, Kanban, Kanban rules, expanded role of conveyance, Production leveling, types of pull system, Value stream mapping. **JIDOKA:** Development of Jidoka concept, Poka-Yoke (mistake proofing) systems, Inspection systems and zone control –Types and use of Poka- Yoke systems, Implementing Jidoka. *Self-Learning and Teamwork:* • Case studies on Value stream mapping (VSM).	09	--
4	**Worker involvement and Systematic Planning Methodology:** Worker Involvement – Activities to support involvement, Kaizen circle activity, Practical Kaizen training, Key factors for PKT success, Suggestion Programmes *Self-Learning and Teamwork:* • Practical implementation of Kaizen techniques.	09	--
5	**Hoshin Planning System** (systematic planning methodology) – Introduction, Hoshin planning system, Four Phases of Hoshin Planning, the culture of Lean production. *Self-Learning and Teamwork:* • Culture of Lean production in industries.	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text books:

1. Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Third Indian edition, CRC Press, 2015.
2. Toyoto production system –An integrated approach to just in time by Yasuhiro Monden – Engineering and Management press – Institute of Industrial Engineers Norcross Georgia 3rd edition 1998.

References:

1. Simplified Lean Manufacture, Elements, Rules, Tools and Implementation by N Gopalakrishnan, PHI Learning Private Ltd., New Delhi 2012.

2. "The Machine that changed the World" by Daniel Roos, 2007.

3. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities, S.R. Devadasan, V.Mohan Sivakumar, R.Murugesh, P.R.Shalij, 2012 edition.

4. Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, Lean Enterprise Institute, 1999.

5. Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity by Richard Schourberger, 1982.

6. "Just in Time Manufacturing" , M. G. Korgaonker MacMillan. Reprinted 2011

7. "Lean thinking" James P.Womack and Daniel T.Jones, 1996.

Web/Digital resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce49/preview

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3	1		3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP651</td><td colspan="5">Course Title: Composite Materials</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course – III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Material Science and Metallurgy

COURSE OBJECTIVE: This course will enable students to:
To impress the student about the study and analysis of composite materials, processing, and fabrication aspects. It also discusses some important care to be taken up in fabricating ceramic matrix composites.

COURSE OUTCOMES (COs): After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the classification and Characteristics of Composite Materials	L1, L2	WK1 to WK4
CO2	Describe the Manufacturing Methods of Metal Matrix Composites -MMC	L1, L2	WK1 to WK4
CO3	Describe The Manufacturing Methods of Polymer Matrix Composites PMC	L1, L2	WK1 to WK4
CO4	Describe The Manufacturing Methods of Ceramic Matrix Composites CMC	L1, L2	WK1 to WK4
CO5	Illustrate the advanced Composites Materials , Nano Composites, Shape Memory Alloy Materials	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Definitions: Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fiber composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites. *Self-Learning and Teamwork:* • Detailed application study on- Types of reinforcements, Types of matrices, Types of composites	09	
2	Manufacturing methods: Metal matrix composites and manufacturing methods, Joining methods and process/failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Metal matrix composites in industries and automobiles.	09	
3	Manufacturing methods: Polymer Matrix composites (PMC)-Manufacturing process, failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Polymer Matrix composites (PMC) in industries and automobiles.	09	
4	Manufacturing methods: Ceramic matrix composites (CMC): Manufacturing process, failure theories –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. [Basic examples for failure analysis] *Self-Learning and Teamwork:* • Applications of Ceramic matrix composites (CMC) in industries and automobiles.	09	
5	Advanced Composites – polymer based Sandwich Sructure, Nano composites, Introduction to Shape memory Alloys *Self-Learning and Teamwork:* • Applications of advanced Composites in Biomedical.	09	

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text books:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York
2. Mechanics of composite materials by Autar Kaw, CRC Press
3. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall
4. Composite materials by J.N. Reddy

Reference Books:

1. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
2. Frank L Matthews and RD Rawlings, (2006), Composite Materials:
3. Engineering and Science, Taylor and Francis D. Hull and T.W. Clyne, (1996),Introduction to Composite Materials, Cambridge University

Web Resources:

1. https://nptel.ac.in/courses/112104229

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP652</td><td colspan="5">Course Title: Non-Traditional Machining</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Elements of mechanical Engineering

COURSE OBJECTIVE: This course will enable students to:

1. To introduce the concept Advance machining process
2. To introduce the concept of EDM, LBM,EBM and USM Process

COURSE OUTCOMES (COs): After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Describe the non conventional methods and USM its process characteristics	L1,L2	WK1 to WK4
CO2	Illustrate the AJM process with parameters and WJM process	L1,L2	WK1 to WK4
CO3	Expound the ECM process its process characteristics	L1,L2,L3	WK1 to WK6
CO4	Explain the EDM types of flushing methods and PAM Process	L1,L2,L3	WK1 to WK6
CO5	Design the LBM and EBM Process its material removal mechanism	L1,L2,L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** History, Classification, comparison between conventional and non- Conventional machining process selection. **Mechanical Process: Ultrasonic Machining (USM):** Introduction, Construction and working process of USM, process Characteristics: - Material removal rate, tool wear Accuracy, surface finish., by graphical representation Applications, Advantages &Disadvantages of USM with Numerical problems *Self-Learning and Teamwork:* • Study on Conventional Vs Non-Conventional machining processes.	**09**	**--**
2	**Abrasive Jet Machining (AJM):** Introduction, Equipment, Variables in AJM, Process Characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish with Graphical representation. Applications, Advantages & Disadvantages of AJM with Numerical problems **Water Jet Machining (WJM):** Introduction, working principle, merits, demerits & applications. *Self-Learning and Teamwork:* • Practical Study on Abrasive Jet Machining (AJM) and Water Jet Machining (WJM).	**09**	**--**
3	**Electrochemical Machining (ECM):** Introduction, Study of ECM machine, Elements of ECM process: -Cathode tool, Anode work piece, source of DC power, Electrolyte. Chemistry of the process, ECM process Characteristics, Material removal rate, Accuracy, Surface finish, Case studies *Self-Learning and Teamwork:* • Practical Study on Electrochemical Machining (ECM).	**09**	**--**
4	**Thermal Metal Removal Processes: Electrical discharge machining (EDM)-**introduction, machine, mechanism of metal removal, dielectric fluid, Flushing methods; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters Advantages, limitations & applications of EDM, Electrical discharge grinding. **Plasma Arc Machining (PAM):** Introduction, equipment non-thermal generation of Plasma, selection of gas, Mechanism of Metal removal, PAM parameters, Process characteristics. Safety precautions, Applications, Advantages and limitations. *Self-Learning and Teamwork:* • Practical Study on Electrical discharge machining (EDM) and Plasma Arc Machining (PAM)	**09**	**--**

5	**Laser Beam Machining (LBM):** Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. **Electron Beam Machining (EBM):** Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations *Self-Learning and Teamwork:* • Practical Study on Laser Beam Machining (LBM) and Electron Beam Machining (EBM).	**09**	**--**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Modern Machining Process- Pandey and Shah, Tata McgrawHill
2. New Technology -Bhattacharaya

Reference Books:

1. Production Technology - HMT TATA McGrawHill.
2. Production Technology -R.K.Jain
3. Production Technology -O.P.Khanna
4. Production Technology - AmitabhGhosh&Mallik

Web Resources:

1. https://nptel.ac.in/courses/112104229 0Course Articulation

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3	1		3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP653</td><td colspan="5">Course Title: World class manufacturing</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: Learn the basics of World Class Manufacturing concepts like Benchmarking, Reengineering and Total Productive Maintenance. Also, learn the economics behind technology implementation.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles and role of WCM	L1, L2	WK1 to WK4
CO2	Discuss the effects of Reengineering in the effective diffusion of WCM by the industry with suitable industry examples	L1, L2, L3	WK1 to WK6
CO3	Describe the various Benchmarking practices to be arrived at for the effective implementation of WCM in industries and apply the techniques to reap the benefits	L1, L2, L3	WK1 to WK6
CO4	Critically analyze the various Modern tools of WCM to clearly optimize the various functions of industry for the smooth functioning of the organization	L1, L2, L3	WK1 to WK6
CO5	Analyze the various bottlenecks in implementing the WCM by incorporating TRIZ principles	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Principles and Practices of WCM:** Introduction to WCM, Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management **Gaining Competitive Edge Through World Class Manufacturing:** Manufacturing Excellence and Competitiveness, What is world-Class Manufacturing, Hall's framework of world-Class Manufacturing (WCM), Gunn's Model of World-Class Manufacturing, Maskell's Model of WorldClass Manufacturing, America's Best Plants Model of World Class Manufacturing. *Self-Learning and Teamwork:* • Industry Application of Deming's & Shingo's Approach to Quality Management	09	-
2	**Definition of Reengineering:** Definition of reengineering, Michael Porter's five factor Model applicable to product and service organizations, Case studies on five factor model. **Importance of 3Cs**-customers takes charges, Characteristics of BPR, Role of information technology in reengineering process, barriers to reengineering, Deming prize and Baldridge award *Self-Learning and Teamwork:* • Case studies on five factor model.	09	-
3	**Benchmarking:** Definition, mission and objectives, managing benchmarking process, phases of benchmarking process, Xerox's and AT&T's benchmarking process, Documentation, performance measures, improving business processes. Whom to benchmarks: Developing candidate list, systematic search, refining the initial list. **Employee engagement**: Motivation, Employee surveys, Empowerment, Team dynamics. Decision making methodology, Suggestion system, Performance appraisal, Unions and employee involvement, benefits of employee involvement. *Self-Learning and Teamwork:* • Significance of Performance appraisal systems in industries.	09	-
4	**Total Productive Maintenance**: Introduction, Foundational Pillars of TPM, The Plan, Learning the New Philosophy, Promoting the Philosophy, Loss areas of TPM and OEE, Training, Improvement Needs, Goal, Developing Plans, Case examples. **Modern Management Tools**: Why-Why analysis, Force Field Analysis, Nominal Group technique, Affinity diagram, Interrelation diagraph, Process Decision Program Chart, Activity network diagram. *Self-Learning and Teamwork:* • Case examples on Total Productive Maintenance. • Case examples on Modern Management Tools.	09	-

5	**Theory of Inventive Problem Solving (TRIZ)**, Overview of 40 principles and 39 Parameters, applications of TRIZ and case examples on minimum ten principles. **Six Sigma:** The Basics, The core of Six Sigma (DMAIC), design for Six Sigma, DFSS and the customer, Quality time and the Bottom line , core of DFSSIDOV method, DFSS Metrics, DFSS Infrastructure –People and resources, Implementing DFSS *Self-Learning and Teamwork:* • Case Study on minimum ten principles of Theory of Inventive Problem Solving (TRIZ).	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Reengineering the corporation -Hammer, Michael and James Champy.
2. A Manifesto for Business revolution, Nicholas Brealey Publishing, London. 1993
3. Finding and implementing best practices -Champ, Robert C. Business Process Benchmarking, Vision Books- New Delhi –2008
4. World class manufacturing -Sahay B S , Saxena K B C, Ashish Kumar, - A Strategic Perspective: MacMillan – India Ltd, ISBN0333-93-4741.
5. Six sigma for Managers -Greg Brue, TMH 2002, ISBN-0-07-048639-5

Reference Books:

1. Design for Six Sigmain Technology and Product Development -Creveling, Pearson Education.
2. Total Quality Management -Dale H. Besterfield, carol Besterfield-Minchna, glen H Besterfield and Mary Besterfield –scare, Pearson education, ISBN81-297-0260-6
3. Total Quality Management - Kesavan R - I K International Publishing house Pvt. Ltd

Web Resources:

1. https://nptel.ac.in/courses/110

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP654</td><td colspan="6">Course Title: Value Engineering</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course-III)</td><td colspan="2">Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: Learn the basics of Value Analysis concepts like Value Engineering, Value management, Evaluation of function by comparison, Evaluation of Interacting functions, Problem Setting & Solving System, Advanced Value Analysis Techniques, Application of Value Analysis.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain Value management, Value Analysis versus Value Engineering.	L1, L2	WK1 to WK4
CO2	Discuss the effect of Function and Functional cost, Rules for functional definition, Types of functions and MISS technique.	L1, L2	WK1 to WK4
CO3	Describe the various Problem Setting & Solving System, Value Engineering Job Plan.	L1, L2	WK1 to WK4
CO4	Discuss the Value Engineering Techniques, Result Accelerators and New Value Engineering Techniques	L1, L2	WK1 to WK4
CO5	Discuss the application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Value Analysis:** Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept. **Type of Values:** Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. *Self-Learning and Teamwork:* • Case study on Value Analysis VS Value Engineering	09	-
2	**Functional Cost and its Evaluation:** Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships. *Self-Learning and Teamwork:* • Case Study on Numerical evaluation of functional relationships	09	-
3	**Problem Setting & Solving System:** A problem solvable stated is half solved, steps in problem setting system, Identification, Separation and Grouping of functions. Various steps in problem solving, case studies. **Value Engineering Job Plan:** Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal. *Self-Learning and Teamwork:* • Case studies on problem solving.	09	-

4	**Value Engineering Techniques:** Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, **Advanced Value Analysis Techniques:** Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems *Self-Learning and Teamwork:* • Case examples for each of the Value Engineering Techniques.	09	-
5	**Application of Value Analysis:** Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques. *Self-Learning and Teamwork:* • Case study on Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. **Techniques of Value Analysis and Engineering** – Lawrence D.Miles - McGraw Hill Book Company - 2nd Edn.
2. **Value engineering for Cost Reduction and Product Improvement** M.S. Vittal - Systems Consultancy Services - Edn 1993.
3. **Value Management, Value Engineering and Cost Reduction** – Edward D Heller - Addison Wesley Publishing Company – 1971.

Reference Books:

- Value Analysis for Better Management – Warren J Ridge American Management Association Edn 1969
- Getting More at Less Cost (The Value Engineering Way) – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995
- Value Engineering – Arther E Mudge McGraw Hill Book Comp. Edn 1981

Web resources:

Value Engineering | PPT (slideshare.net)
https://youtu.be/mJoaZ4GewyI
https://youtu.be/mqC4Wn_OK-I
https://youtu.be/mSkVsslcZKw

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP661</td><td colspan="5">Course Title: Database Management Systems</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC [Professional Elective Course-IV]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: To study data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO-1	Explain the characteristics of Data Base Approach and Advantages of using DBMS Approach	L1,L2	WK1 to WK4
CO-2	Illustrate data Modelling Using the Entity –relationship [ER] Model and RDBMS	L1,L2	WK1 to WK4
CO-3	Demonstrate the Relational Algebra and to Use the Practical Knowledge on Basic SQL, More Complex SQL retrieval Queries	L1,L2	WK1 to WK4
CO-4	Demonstrate the Data base Design theory and normalization using case Study	L1,L2, L3	WK1 to WK6
CO-5	Illustrate the Transaction Processing , Concurrency control and Recovery	L1,L2,	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Database Concepts and Architecture:** Introduction; An example; Characteristics of Database approach; Database users, Advantages of using DBMS approach, Data models, schema and instances, Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of DBMS. *Self-Learning and Teamwork:* • Case study on Characteristics of Database approach	09	-
2	**Data Modeling Using the Entity-Relationship (ER) Model:** Using High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions, and Design Issues, Relationship Types of Degree Higher than Two, Relational Database Design Using ER- to-Relational Mapping **The Relational Data Model and Relational Database Constraints**: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations, Big Data, Spread sheet software. *Self-Learning and Teamwork:* • Practical Approach on Data Modeling Using the Entity-Relationship (ER) Model	09	-
3	**The Relational Algebra:** Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations: Generalized Projection, Aggregate Functions and Grouping, OUTER JOIN Operations, Examples of Queries in Relational Algebra **Basic SQL:** SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, More Complex SQL retrieval Queries, Specifying Constraints as Assertions and Actions as Triggers, Views (Virtual Tables) in SQL. *Self-Learning and Teamwork:* • Create student data base by using SQL Commands	09	-

4	**Database Design Theory and Normalization:** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form, Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions. **AI Component**: **Data Analysis and Insights:** AI can process and analyze vast amounts of data to identify patterns, trends, and anomalies, enabling organizations to make more informed decisions. *Self-Learning and Teamwork:* • Study on Data Abstraction	09	-
5	**Transaction Processing, Concurrency Control, and Recovery:** Introduction to Transaction Processing, Transactions, Database Items, Read and Write Operations and DBMS Buffers, Why Concurrency Control is Needed, Why Recovery Is Needed, Desirable Properties of Transactions, Two-Phase Locking Techniques for Concurrency Control. *Self-Learning and Teamwork:* • Study on ACID Properties	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition,Pearson Education, 2 16.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rdEdition,McGraw-Hill, 2 15.
2. Silberschatz, Korth and Sudharshan, Data base System Concepts, 6th Edition, Mc-GrawHill, 2 16.
3. C.J. Date, A. Kannan, S. Swamynatham, An Introduction to Database Systems, 8thEdition,Pearson Education, 2 16.
4. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementationand Management, Cengage Learning 2 12

Web Resources:

1. http://nptel.ac.in/courses/1 61 6 93/
2. https://nptel.ac.in/courses/1 6/1 4/1 614

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3	1		3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP662</td><td colspan="5">Course Title: Project Management</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC [Professional Elective Course-IV]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td colspan="2" rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td rowspan="2">45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -Nil-

COURSE OBJECTIVES: The course aims to provide a comprehensive understanding of project management by covering key concepts, including project categories
Course focuses on developing practical skills in project planning and estimating, organizing and staffing project teams, utilizing tools and techniques for project management.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand and explain the concepts of Project Management	L1, L2	WK1 to WK4
CO2	Apply the knowledge to identify the resources needed for each stage, including stakeholders, tools and supplementary materials	L1, L2, L3	WK1 to WK6
CO3	Analyze project management tools and apply the same in real time project execution.	L1, L2,L3	WK1 to WK6
CO4	Analyze how cost can be managed to execute the project in allocated budget.	L1, L2, L3	WK1 to WK6
CO5	Analyze the project for customer satisfaction and follow the clean up stage..	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 Create

Course Content / Syllabus:

Unit No.	Content	Hours	
		Lecture	Tutorial
1	**CONCEPTS OF PROJECT MANAGEMENT**: Concept of a Project, Categories of projects, Phases of project life cycle curve, Project Visibility. *Self-Learning and Teamwork:* • Practical approach on -Phases of project life cycle curve	09	-
2	**PROJECT PLANNING AND ESTIMATING**: Feasibility report of phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, and evaluation of the project profitability. *Self-Learning and Teamwork:* • Case studies on cost estimation	09	-
3	**ORGANIZING AND STAFFING THE PROJECT TEAM**: Authorities and responsibilities of a project manager, Project organization and types, accountability in project execution, Contracts, 3 R's of contracting, Tendering and selection of contractors, tendering procedure. *Self-Learning and Teamwork:* • Case Study on Organizing and staffing the project team	09	-
4	**TOOLS & TECHNIQUES OF PROJECT MANAGEMENT**: Project selection Techniques, Project execution planning techniques, Project scheduling and coordinating techniques, project monitoring and progressing techniques, project cost and productivity control techniques, project communication and clean up techniques. *Self-Learning and Teamwork:* • Practical Approach on Work breakdown structure (WBS)	09	-
5	**PERFORMANCE MEASURES IN PROJECT MANAGEMENT**: Performance indicators. Project audit and closure: Project audits, Guidelines for conducting a project audit, steps in project audit. Project closure: conditions for project closure, closure decision, project closure process, evaluation of team, team members, and project manager. *Self-Learning and Teamwork:* • Case studies on performance indicators of project	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

TEXT BOOKS:

1. Project Management, ChaudhryS.TataMcGraw hill, ISBN-13:978- - 7-46 68-9
2. Project Management a System approach to Planning Scheduling & Controlling, Harold Kerzner, CBS Publishers and Distributors
3. Project Management – Clifford F. Gray, Eric W. Larson, Gautam V. Desai. Tata-McGraw Hill

REFERENCE BOOK:

1. Project Management - Beningston Lawrence-McGraw Hill-197 .
2. PERT & CPM - L.S. Srinath, Affiliated East West Press Pvl. Ltd
3. Project Planning analysis selection implementation & review - Prasanna Chandra, ISBNO 7-462 49-5.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_mg3

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP663</td><td colspan="4">Course Title: Total Quality management</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC
(Professional Elective Course-IV)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -Nil-

Course Objectives:

Develop an understanding on the necessary information and skills needed to manage, control and improve quality practices in the organizations through TQM philosophy.

Explain the four revolutions in management thought processes.

Apply the reactive and proactive improvement methodologies for problem solving in organizations.

Demonstrate the importance of team work in problem solving processes.

Evaluate the business excellence models implemented in various organizations.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Develop an understanding on the necessary information and skills needed to manage, control and improve quality practices in the organizations through TQM philosophy.	L1,L2,L3	WK1 to WK4
CO2	Explain the four revolutions in management thought processes.	L1,L2	WK1 to WK4
CO3	Apply the reactive and proactive improvement methodologies for problem solving in organizations.	L1,L2,L3	WK1 to WK4
CO4	Explain the importance of team work in problem solving processes.	L1,L2	WK1 to WK6
CO5	Illustrate the business excellence models implemented in various organizations.	L1,L2,L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 –Evaluate, L6- Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Quality Pioneers:** Deming's approach, Juran's quality trilogy, Crosby and quality treatment, Imai's Kaizen, Ishikawa's company-wide quality control, and Feigenbaum's theory of TQC. **Evolution of Quality Concepts and Methods:** Quality concepts, Development of four fitness's, evolution of methodology, evolution of company integration. *Self-Learning and Teamwork:* • Contribution of Quality Gurus	09	-
2	**Four Revolutions in Management thinking, Focus on customers**: Change in work concept, market- in, and customers. **Continuous Improvement:** Improvement as problem solving process: Management by process, WV model of continuous improvement. **Reactive Improvement**: Identifying the problem, standard steps, seven steps case study, General guidelines for managers diagnosing a QI story. **Proactive Improvement:** Introduction to proactive improvement, standard steps for proactive improvement, semantics, Seven Management and Planning Tools. *Self-Learning and Teamwork:* • Management by Objectives(MBO)	09	-
3	**Total Participation**; Teamwork skill, Dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, Initiation strategies, **Hoshin Management**: Definition, Concepts, Phases in Hoshin Management – overview. **Societal Networking:** Networking and societal diffusion, infrastructure for networking. TQM as learning system, a TQM model for skill development. *Self-Learning and Teamwork:* • Case *Studies on employee engagement*	09	-
4	**Introduction to Six Sigma:** Benefits, fundamentals, myths, essentials and costs of Six Sigma. Assessing readiness for Six Sigma, five key players, Planning for the Six Sigma initiative. Case discussions. **Statistical Foundation:** Variation & causes, normal distribution, process capability, rolled throughput yield, Cost of poor quality. **Metrics for Six Sigma:** The critical-to-quality concept, criteria to metrics, universal standard, baselines, benchmarking, guidelines for metrics. *Self-Learning and Teamwork:* • Practical approach on Process capability studies and Cost of Quality	09	-
5	**Project Selection:** Project selection process, evaluating projects. Project selection matrix, project review. DMAIC phases. **Design for Six Sigma:** Overview of DFSS, DMADV Method. **Beyond Six sigma:** Supply chain management using Lean and Six Sigma, Knowledge management and Six Sigma, Growth Management System – building blocks and architecture. *Self-Learning and Teamwork:* • Case Study on Growth Management System – building blocks and architecture	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Total Quality Management Dale H. Besterfield Pearson Education India, Edition 3. ISBN: 81297 26 6,
2. Total Quality Management for Engineers M. Zairi Wood head Publishing ISBN:185573 24
3. Total Quality Management, NVR Naidu, KM Babu, G Rajendra, New Age International Publishers, ISBN: 978-81-224-1799-9

Reference Books:

1. Shoji Shiba, Alan Graham and David Walden, A New American TQM – Four Practical Revolutions in Management, Productivity Press, Portland (USA), 2nd Edition, 1993, ISBN: 978156327 321 Greg Brue and Rod Howes, Six Sigma, TATA McGraw-Hill Edition 2 6, ISBN: - 7- 63468-8
2. N Logothetis , Managing for total quality: from Deming to Taguchi and SPC, Prentice Hall of India, 1993, ISBN: 978- 133535127
3. Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield – Sacre, Total Quality Management, Pearson Education, 2 2, 3rd Edition, ISBN-81-297- 26 -6.

Web Resources:

https://archive.nptel.ac.in/courses/11 /1 4/11 1 4 8 /

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3			3	3						3	2	1
CO4	3	3	1		3	3						3	2	1
CO5	3	3	1		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code:24IP664</td><td colspan="5">Course Title: Organizational Behavior</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course-IV)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td rowspan="2">45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21+24)

Pre Requisite: NIL

Course objective:

Students will learn the concepts of OB based on different models understand the foundations of individual and group behavior which affect the organizational performance and effectiveness.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles and roles of Organizational Behavior	L1, L2	WK1 to WK4
CO2	Discuss the various learning modules with case examples from Industry perspective	L1, L2, L3	WK1 to WK6
CO3	Describe the various values and attributes and effectively apply the communication skills without the barriers of communications.	L1, L2, L3	WK1 to WK6
CO4	Critically analyze the various Modern tools of Motivations in enhancing the effectiveness of the employees work culture and critically instruct the industry personnel to implement for the smooth functioning of the organization	L1, L2, L3	WK1 to WK6
CO5	Analyze the various bottlenecks of handling the groups and behavior of Group with importance to the Group Dynamics	L1, L2, L3	WK1 to WK6

Course Content / Syllabus:

Unit No.	Course Content	No. of Hours	Tutorial
1	**Introduction:** Definition of Organization Behavior and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems). The Individual: Foundation of individual behavior, Personality theory and Individual ability. *Self-Learning and Teamwork:* • Case study on -Environmental context (Information Technology and Globalization)	09	-
2	**Learning:** Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social making, learning theory, Dreyfus Skill acquisition principles, continuous and intermittent reinforcement. Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect. *Self-Learning and Teamwork:* • A case study on Theories of Learning	09	-
3	**Values and Attitudes:** Definition – values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance, Values and attitudes- terminal values and instrumental values, formation of attitudes, sources of attitudes and measurement of attitudes. Organizational communication types, mediums and barriers to communication, Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process *Self-Learning and Teamwork:* • A Case Study on stages of conflict process	09	-
4	**Motivation**: Maslow's Hierarchy of Needs, Mc. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor Vroom's expectancy theory of motivation. **Leadership**: Definition, Behavioral theories – Blake and Mounton managerial grid, Contingency theories – Hersey - Blanchard 's situational theory, Leadership styles – characteristics, Transactional, transformation leaders *Self-Learning and Teamwork:* • A case study on expectancy theory of motivation.	09	-

5	**The Group:** Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making. Workplace stress management and job satisfaction-its relationship to productivity, *Self-Learning and Teamwork:* • Practical approach to monitor the absenteeism and employee turn over	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

TEXT BOOKS:

1. Organizational Behavior - Stephen P Robbins –Pearson Education Publications, 18th Edition
2. Organizational Behavior – Fred Luthans– Mc GrawHill, 12th International Edition

REFERENCE BOOKS:

1. Organizational Behavior – Hellriegel, Srocum and woodman, Thompson Learning - Prentice HallIndia, 9th Edition.
2. Management of Organizational Behavior - Paul Henry and Kenneth H. Blanchard - Prentice Hall of India, 8th Edition.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	2		3	3						3	2	1
CO3	3	3	2		3	3						3	2	1
CO4	3	3	2		3	3						3	2	1
CO5	3	3	2		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP671OE</td><td colspan="6">Course Title: Organizational Behavior</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: OEC(Open Elective-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td colspan="2" rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td rowspan="2">45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 +24)

Pre Requisite: NIL

Course objective:

Students will learn the concepts of OB based on different models understand the foundations of individual and group behavior which affect the organizational performance and effectiveness.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles and roles of Organizational Behavior	L1, L2	WK1 to WK4
CO2	Discuss the various learning modules with case examples from Industry perspective	L1, L2, L3	WK1 to WK6
CO3	Describe the various values and attributes and effectively apply the communication skills without the barriers of communications.	L1, L2, L3	WK1 to WK6
CO4	Critically analyze the various Modern tools of Motivations in enhancing the effectiveness of the employees work culture and critically instruct the industry personnel to implement for the smooth functioning of the organization	L1, L2, L3	WK1 to WK6
CO5	Analyze the various bottlenecks of handling the groups and behavior of Group with importance to the Group Dynamics	L1, L2, L3	WK1 to WK6

Course Content / Syllabus:

Unit No.	Course Content	No. of Hours	Tutorial
1	**Introduction:** Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems). The Individual: Foundation of individual behavior, Personality theory and Individual ability. *Self-Learning and Teamwork:* • Case study on -Environmental context (Information Technology and Globalization)	09	-
2	**Learning:** Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social making, learning theory, Dreyfus Skill acquisition principles, continuous and intermittent reinforcement. Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect. *Self-Learning and Teamwork:* • A case study on Theories of Learning	09	-
3	**Values and Attitudes:** Definition – values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance, Values and attitudes- terminal values and instrumental values, formation of attitudes, sources of attitudes and measurement of attitudes. Organizational communication types, mediums and barriers to communication, Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process *Self-Learning and Teamwork:* • A Case Study on stages of conflict process	09	-
4	**Motivation**: Maslow's Hierarchy of Needs, Mc. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor Vroom's expectancy theory of motivation. **Leadership**: Definition, Behavioral theories – Blake and Mounton managerial grid, Contingency theories – Hersey - Blanchard 's situational theory, Leadership styles – characteristics, Transactional, transformation leaders *Self-Learning and Teamwork:* • A case study on expectancy theory of motivation.	09	-

5	**The Group:** Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making. Workplace stress management and job satisfaction-its relationship to productivity, *Self-Learning and Teamwork:* • Practical approach on monitor the absenteeism and employee turn over	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

TEXT BOOKS:

1 Organizational Behavior - Stephen P Robbins –Pearson Education Publications, 18th Edition 4. Organizational Behavior – Fred Luthans– Mc GrawHill, 12th International Edition

REFERENCE BOOKS:

1. Organizational Behavior – Hellriegel, Srocum and woodman, Thompson Learning - Prentice HallIndia, 9th Edition.
2. Management of Organizational Behavior - Paul Henry and Kenneth H. Blanchard - Prentice Hall of India, 8th Edition.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3	2		3	3						3	2	1
CO3	3	3	2		3	3						3	2	1
CO4	3	3	2		3	3						3	2	1
CO5	3	3	2		3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP672OE</td><td colspan="5">Course Title: World class manufacturing</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: OEC(Open Elective-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="6">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: Learn the basics of World Class Manufacturing concepts like Benchmarking, Reengineering and Total Productive Maintenance. Also, learn the economics behind technology implementation.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles and role of WCM	L1, L2	WK1 to WK4
CO2	Discuss the effects of Reengineering in the effective diffusion of WCM by the industry with suitable industry examples	L1, L2, L3	WK1 to WK6
CO3	Describe the various Benchmarking practices to be arrived at for the effective implementation of WCM in industries and apply the techniques to reap the benefits	L1, L2, L3	WK1 to WK6
CO4	Critically analyze the various Modern tools of WCM to clearly optimize the various functions of industry for the smooth functioning of the organization	L1, L2, L3	WK1 to WK6
CO5	Analyze the various bottlenecks in implementing the WCM by incorporating TRIZ principles	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Principles and Practices of WCM:** Introduction to WCM, Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management **Gaining Competitive Edge Through World Class Manufacturing:** Manufacturing Excellence and Competitiveness, What is world-Class Manufacturing, Hall's framework of world-Class Manufacturing (WCM), Gunn's Model of World-Class Manufacturing, Maskell's Model of WorldClass Manufacturing, America's Best Plants Model of World Class Manufacturing. *Self-Learning and Teamwork:* • Industry Application of Deming's & Shingo's Approach to Quality Management	09	-
2	**Definition of Reengineering:** Definition of reengineering, Michael Porter's five factor Model applicable to product and service organizations, Case studies on five factor model. **Importance of 3Cs**-customers takes charges, Characteristics of BPR, Role of information technology in reengineering process, barriers to reengineering, Deming prize and Baldridge award *Self-Learning and Teamwork:* • Case studies on five factor model.	09	-
3	**Benchmarking:** Definition, mission and objectives, managing benchmarking process, phases of benchmarking process, Xerox's and AT&T's benchmarking process, Documentation, performance measures, improving business processes. Whom to benchmarks: Developing candidate list, systematic search, refining the initial list. **Employee engagement**: Motivation, Employee surveys, Empowerment, Team dynamics. Decision making methodology, Suggestion system, Performance appraisal, Unions and employee involvement, benefits of employee involvement. *Self-Learning and Teamwork:* • Significance of Performance appraisal systems in industries.	09	-

4	**Total Productive Maintenance**: Introduction, Foundational Pillars of TPM, The Plan, Learning the New Philosophy, Promoting the Philosophy, Loss areas of TPM and OEE, Training, Improvement Needs, Goal, Developing Plans, Case examples. **Modern Management Tools**: Why-Why analysis, Force Field Analysis, Nominal Group technique, Affinity diagram, Interrelation diagraph, Process Decision Program Chart, Activity network diagram. *Self-Learning and Teamwork:* • Case examples on Total Productive Maintenance. • Case examples on Modern Management Tools.	09	-
5	**Theory of Inventive Problem Solving (TRIZ)**, Overview of 40 principles and 39 Parameters, applications of TRIZ and case examples on minimum ten principles. **Six Sigma:** The Basics, The core of Six Sigma (DMAIC), design for Six Sigma, DFSS and the customer, Quality time and the Bottom line , core of DFSSIDOV method, DFSS Metrics, DFSS Infrastructure –People and resources, Implementing DFSS *Self-Learning and Teamwork:* • Case Study on minimum ten principles of Theory of Inventive Problem Solving (TRIZ).	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Reengineering the corporation -Hammer, Michael and James Champy.
2. A Manifesto for Business revolution, Nicholas Brealey Publishing, London. 1993
3. Finding and implementing best practices -Champ, Robert C. Business Process Benchmarking, Vision Books- New Delhi –2008
4. World class manufacturing -Sahay B S , Saxena K B C, Ashish Kumar, - A Strategic Perspective: MacMillan – India Ltd, ISBN0333-93-4741.
5. Six sigma for Managers -Greg Brue, TMH 2002, ISBN-0-07-048639-5

Reference Books:

1. Design for Six Sigmain Technology and Product Development -Creveling, Pearson Education.
2. Total Quality Management -Dale H. Besterfield, carol BesterfieldMinchna, glen H Besterfield and Mary Besterfield –scare, Pearson education, ISBN81-297-0260-6
3. Total Quality Management - Kesavan R - I K International Publishing house Pvt. Ltd

Web Resources:

2. https://nptel.ac.in/courses/110

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP673OE</td><td colspan="6">Course Title: Additive Manufacturing</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: OEC(Open Elective-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: To introduce students basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques, and appreciate the difference between subtractive manufacturing and additive manufacturing, learn the concept of joining of materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodology.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the importance of prototyping concepts with emphasis on Rapid manufacturing processes, and role of additive manufacturing in product development.	L1, L2	WK1 to WK4
CO2	Analyze the techniques of Liquid and Solid based Additive Manufacturing Systems and its applications in various domains.	L1, L2	WK1 to WK4
CO3	Apply Rapid Tooling and Additive manufacturing in range of domains from engineering and other fields.	L1, L2, L3	WK1 to WK6
CO4	Understand the concepts of Reverse Engineering and different types of STL format	L1, L2	WK1 to WK4
CO5	Illustrate the Application of Additive Manufacturing	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), and classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process. **Overview of additive manufacturing**– History – Need-Classification -Additive Manufacturing Technology in Product Development-Materials for Additive Manufacturing Technology – Tooling – Applications *Self-Learning and Teamwork:* • Refine Ideas for Traditional Prototyping Vs. Rapid Prototyping (RP)	09	-
2	**Liquid based additive Manufacturing systems:** Classification – Liquid based system – Stereolithography Apparatus (SLA)-Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, **Solid based AM Systems:** Laminated Object Manufacturing (LOM): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. *Self-Learning and Teamwork:* • Case studies On Liquid based manufacturing systems	09	-
3	**Powder based Additive manufacturing and 3d printing systems:** Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three-Dimensional Printing – Principle, process, advantages and applications-Laser Engineered Net Shaping (LENS), Electron Beam Melting. **Multi Jet Modelling (MJM):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. *Self-Learning and Teamwork:* • Industry application of Powder based Additive manufacturing and 3d printing systems	09	-

4	**AM & Reverse Engineering:** Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology, concept of Reverse Engineering, nature and characteristics. **AM Data formats: Reengineering for digital representation:** STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs. AM Software's: Need for AM software, Features of various AM software. *Self-Learning and Teamwork:* • Real world application of Reverse Engineering- its Basic concepts	09	-
5	**Rapid Tooling:** conventional tooling vs RT, need for RT. Rapid tooling classification**,** Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Kel tool process **AM applications:** Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture *Self-Learning and Teamwork:* • Industry application of 3D Kel tool process	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Book:

1. Chua C.K., Leong K.F., and Lim C.S., —Rapid prototyping: Principles and applications ,Third Edition, World Scientific Publishers.
2. GebhardtA — Rapid prototyping, Hanser Gardener Publications.

Reference Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, Springer, Brent Stucker, David W. Rosen, and IanGibson,
2. Liou L.W. and Liou F.W.,—Rapid Proto typing and Engineering applications: A toolbox for prototype development , CRC Press
3. KamraniA.K. and Nasr E.A., —Rapid Prototyping: Theory and practice , Springer, 2 6.

Web Resources:

1. https://nptel.ac.in/courses/1121 33 6 Course

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3						3	2	1
CO2	3	3			3	3						3	2	1
CO3	3	3	1		3	3						3	2	1
CO4	3	3			3	3						3	2	1
CO5	3	3			3	3						3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP674OE</td><td colspan="4">Course Title: Marketing Management</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td>Course Category: OEC(Open Elective-III)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="3">Weightage %

Maximum Marks

Minimum Marks</td><td rowspan="3">40

40

20</td><td rowspan="3">60

60

25</td><td rowspan="3">100

100

45*</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td></tr>
<tr><td>Total</td><td>90</td><td colspan="3"></td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: Students will get an insight on importance of marketing and skills required to manage marketing.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working knowledge
CO1	Explain the concepts of Consumer markets and their behavior with its significance	L1, L2	WK1 TO WK4
CO2	Describe the impacts of Market Research & MIS in analyzing the data and arrive at suitable decisions.	L1,L2, L3,L4	WK1 TO WK6
CO3	Illustrate the Product life cycle and arrive at suitable decision making for its effective implementation with case examples.	L1, L2,L3	WK1 TO WK6
CO4	Sensitization of the effects in choosing right pricing and channels for Marketing of goods and services	L1, L2	WK1 TO WK4
CO5	Explain the roles and significance of Packaging, Branding and apply these with suitable case examples	L1, L2, L3	WK1 TO WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Market, Marketing and Marketing Management: Introduction:** Historical development marketing management, tasks and philosophies, modern marketing concepts, importance of marketing in the India Socio–economic system. Marketing System- Company marketing system – levels in marketing environment of a company, marketing process, marketing mix, and marketing strategy. **Consumer Markets and Buying Behavior:** Classification of consumer products, participants in the consumer buying decision, factors influencing consumer buying behaviour, characteristics influencing, Consumer behaviour, major stages in buying process. *Self-Learning and Teamwork:* • Online consumer behaviour	09	-
2	**Marketing Information Systems and Research:** Components of marketing information system. A sample case study towards establishing a Marketing information systems – benefits and uses marketing research system **Marketing Research**: Steps of marketing research, measurement of market demand. Types of Market Research, Feasibility study for a consumer product. *Self-Learning and Teamwork:* • Tools used in Marketing information systems	09	-
3	**Products Planning and Development:** The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of "New – product; major stages in new – product development product life cycle. *Self-Learning and Teamwork:* • Case study on product life cycle	09	-

4	**Pricing and Distribution:** Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions. Distribution channels **Marketing channels**: Functions, types of channels of distribution number of channel levels, Role of Digital Marketing, Practical aspects in using Social Media platforms. *Self-Learning and Teamwork:* • Case study on Pricing strategy • Social media marketing • Logistics	**09**	**-**
5	**Branding, Labeling, and Packaging:** Branding Reasons for branding, functions of branding features of types of brands, kinds of brand name. Labeling - Types, functions advantages and disadvantages, Packaging- Meaning, growth of packaging, function of packaging, kinds of packaging, Copy rights and Trade Marks, Patents. **Advertising and Sales Promotion:** Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media– kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion. *Self-Learning and Teamwork:* • Study on the consideration on the weightage of branding, labelling and packaging. • Basic principles of advertising and sales promotion	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Philip Koteler “Principles of Marketing”, Prentice – Hall.
2. Philip Koteler “Marketing Management”, Prentice – Hall.
3. Michael R Czinkota, Marketing Management, 2nd Edition, Vikas Publishing House, ISBN 981-240-366-3

Reference Books:

1. Wiliam J Stannon, “Fundamentals of Marketing”, McGraw Hill
2. R.S.N. Pillia and Mrs. Bagavathi “Marketing” S. Chand & Co. Ltd
3. S.A Sherlaker, “Marketing Management”
4. Rajagopal, marketing Management Text & Cases, Vikas Publishing House, ISBN 81- 259-0773-

Web Resources:

https://onlinecourses.nptel.ac.in/noc22_mg5

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3	1		3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP67L		Course Title: Computer Aided Manufacturing Lab				
Total Credits: 1.5 L- 0: T- : P-45 : SL and TW-0		SDGs addressed: 4,9 & 12			Course Category: PCCL	Course Type: Laboratory
Teaching Learning Process		Total Contact hours/Semester	Assessment in Weightage and marks			
	Lecture	-		CIE	SEE	Total
	Tutorial	-	Weightage %	40	60	100
	Practical	45	Maximum Marks	40	60	100
	Self-Learning and Teamwork	-	Minimum Marks	20	25	45*
	Total	45				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Computer Aided Design.

COURSE OBJECTIVES: The topic covers the aspects of CNC technology and the programming for the CNC lathe, milling jobs.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand and apply the knowledge in writing the ISO programs for the turning and milling programme.	L1, L2, L3	WK1 to WK6
CO2	Apply the simulation software in understanding the concepts of CNC lathe and Milling programs and learns the syntax and other intricate programming features.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours		
		Lecture	Tutorial	Practical
1	**Laboratory Classes** Writing and Execution of CNC programs using CNC lathe and Machining Centre software a. CNC lathe programming – Simple programs on lathe- Canned Cycle Programming for lathe, subroutines, – Lab Exercises with related theory. b. CNC Milling programming – Simple programs on latheCanned Cycle Programming for Milling, controllers, subroutines – Lab Exercises with related theory	-	-	30
2	**Generation of ISO codes using CAM packages for Lathe and Milling Machines** a. CNC lathe programming – Simple programs on lathe, Canned Cycle Programming for lathe controllers, subroutines– Lab Exercises b. CNC Milling programming – Simple programs on lathe, Canned Cycle c. Programming for Milling, subroutines – Lab Exercises	-	-	15

Text Books:

1. CNC programming Manuals
2. CAD/CAM principles and applications by P N Rao 3. CAD/CAM by Groover.

Reference Books:

1. Introduction to design & analysis of algorithms - S.E.Goodman, S.T.Headetmiemi
2. Principles of interactive computer graphics by Newman & Sproul
3. Computer graphics by Steven Harrington
4. CAD-CAM by ChrisMcMahon & JimmieBrowne
5. CAD-CAM by IbrahimZeid

Web resources:

1. https://nptel.ac.in/courses/112/104/112104031/

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 3

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP710</td><td colspan="6">Course Title: SUPPLY CHAIN MANAGEMENT</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PCC</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td colspan="2">Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td colspan="2" rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -NIL-

COURSE OBJECTIVE:

To conceptualize, design and implement supply chains aligned with product, market and customer characteristics. Managing the flow of products & information across supply chains. The ability to understand the supply networks to fulfill customer needs.

COURSE OUTCOMES (COs):

After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the concepts of Supply Chain Management and its dynamics.	L1, L2	WK1 to WK4
CO2	Describe the supply chain management process, supplier relationship and other important related manufacturing philosophy.	L1, L2, L3	WK1 to WK6
CO3	Explain the supply chain distribution network, warehouse management and product reverse logistics process.	L1, L2	WK1 to WK4
CO4	Demonstrate the supply chain strategic planning and development in an organization.	L1, L2, L3	WK1 to WK6
CO5	Explain the importance of customer satisfaction, service and feedback in supply chain system.	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to supply chain management:** Functional views of supply chain management, supply chain players, dynamics. Guide to plan in supply chain management, inventory concept in supply chain and its types, demand and supply chain, sales and operation planning, Guiding principles. *Self-Learning and Teamwork:* • Industry application of Guiding principles	09	--
2	**Guide to source in supply chain management:** purchasing process, tactical sourcing, strategic sourcing, supplier relationship management, negotiation, Guide to Make in Supply Chain Management. From craft to mass manufacturing, types of manufacturing process, JIT, Lean & TQM philosophy, fish bone diagram (only Introduction). *Self-Learning and Teamwork:* • Real world /Industry application Guide to Make in Supply Chain Management	09	--
3	**Guide to Deliver in Supply Chain Management**: distribution network, network trade off, transport management, warehouse management, Guide to Return in Supply Chain Management, why do product return, drivers of reverse logistics, return process, improving returns. *Self-Learning and Teamwork:* • Case study on Guide to drivers of reverse logistics • Case study on Guide to Return in Supply Chain Management	09	--
4	**Guide to Strategy in Supply Chain Management:** what is strategic planning, achieving strategic alignments, concept to support supply chain strategy development, Guide to People in Supply Chain Management, the importance of people in supply chain organization, constructing a learning and development strategy, encouraging a learning culture *Self-Learning and Teamwork:* • Case study on Strategy policies on -Guide to People in Supply Chain Management	09	--
5	**Guide to Customer Service in Supply Chain Management:** introduction, who are our customers, managing variability to improve customer service, customer lifetime value, customer service ambassador, delivering against customer needs, core promise, meeting and exceeding customer expectations, Guide to Outsourcing in Supply Chain Management introduction, common reasons for outsourcing, tending process of outsourcing. *Self-Learning and Teamwork:* • Case study on Customer feedback analysis in Supply Chain Management • Guide to Outsourcing in Supply Chain Management	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Guide to Supply chain management by Colin Scott Henritee Lundgren Paul Thompson (springer) ISBN 978-3-642-17675-3, 2011 Springer Heidelberg Dordrecht London New York.

Reference Books:

1. Supply Chain Management – 2001, Strategy, Planning & Operation. Sunil Chopra & Peter Meindl; Pearson Education Asia, ISBN:81-7808-272-1.
2. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems, Robert B Handfield, Ernest L Nichols, Jr. 2002, Pearson Education Inc, ISBN:81-297-0113-8.
3. Modelling the Supply Chain- Jeremy F Shapiro, Duxbury 2002, Thomson Learning, ISBN 0- 534-37363.

Web Resources:

1. https://supplychaindigital.com/top10/top-10-supply-chain-news-websites
2. https://www.usda.gov/topics/food-and-nutrition/web-based-supply-chain-management
3. https://www.researchgate.net/publication/220208077_Web_technology_and_supply_chain_management

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP721</td><td colspan="5">Course Title: Facilities Planning & Design</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC (Professional Elective Course-V)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td colspan="2" rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -NIL-

COURSE OBJECTIVE:

1. After completion of the course, students will be able to understand the importance of plant location, material handling systems & layout design.
2. Students able to design an optimum plant for production according to manufacturing process, raw material, and other resource.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain about the planning strategies, implementation, evaluation and maintaining the facility and explain various theories of plant location, goals of plant layout.	L1, L2	WK1 to WK4
CO2	Explain the concepts of material handling and basic devices used in material handling with suitable examples.	L1, L2	WK1 to WK4
CO3	Explain the Computerized layout planning like and other aspects of plant design and its advantages and limitations.	L1, L2, L3	WK1 to WK6
CO4	Demonstrate the quantitative methods and models for the plant location.	L1, L2	WK1 to WK4
CO5	Describe the area allocation with the detailed construction of layouts & location Models.	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Plant Location:** Factors influencing plant location, Theories of plant location and location economics, location problems, Objectives of plant layout: Principles of plant layout, types of plant layout, Merits and Demerits of plant layout, Function of Plant layout, types of layout problems. *Self-Learning and Teamwork:* • Industry based Factors influencing Theories of plant location and location economics	09	--
2	**Material Handling:** Principles of material Handling, Objectives of Material handling, Unit load concept, classification of Material handling equipment's, Basic devices used in Material Handling: Basic devices & Types of Material handling equipment, unit load concept with examples. *Self-Learning and Teamwork:* • The main objectives of Material handling concept in industries	09	--
3	**Computerized layout Planning:** CRAFT, COFAD, PLANET, CORELAP, ALDEP, concepts of the above systems and use of flow chart, Plant Design: Systematic layout planning, activity relationship chart, relationship diagram, space relationship diagram to plant layout, approaches to layout procedures. **AI component:** AI/ML Applications in Facility Layout and Design *Self-Learning and Teamwork:* • The basic factors in considerations for Systematic layout planning – for Computerized layout Planning for any industry	09	--
4	**Space Determination:** Space determination and area allocation, factors in space planning, receiving storage production shipping, tool room, tool crib and other auxiliary services, Factors to be considered for expansion, Flexibility aisles, columns etc. *Self-Learning and Teamwork:* • How to plan/Decide for Space Determination /Area Allocation planning in Industries and Factors to be considered for expansion, Flexibility aisles, columns	09	--
5	**Area Allocation:** Allocation procedure for area, plot plan, sequence demand, straight line and directional methods and simple problems, line balancing. Assembly line balancing, fabrication line balancing, simple problem in line balancing, Ranked position weight method, Detailed construction of the layout: Methods of constructing the layout, evaluation of the layout. *Self-Learning and Teamwork:* • The Basic Factors consideration for Assembly line balancing and fabrication line balancing in Industries	09	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Plant layout and material handling- James Apple, John, Wiely and Sons,2nd Edition.
2. Facilities Planning –James A.Tomkins, John A.White, YavuzA.Bozer, J M.A.Tanchoco, John Wiley and Sons

Reference Books:

1. Facilities Design –Sunderesh Heragu, PWS Publishing Company, ISBN-0-534-95183. 2. Plant Layout Design - James M Moore, Mc Milan Co.1962 LCCCN61- 5204
2. Facilities planning and Design – Tompkins.

Web Resources:

1. https://nptel.ac.in/courses/103105166
2. https://nptel.ac.in/courses/112107143

Course Articulation:

POs → COs ↓	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			3	3					3	3		
CO2	3	3			3	3					3	3		
CO3	3	3	1		3	3					3	3		
CO4	3	3			3	3					3	3		
CO5	3	3			3	3					3	3		

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP722</td><td colspan="6">Course Title: INDUSTRY 4.0</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC [Professional Elective Course-V]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: To understand the key concepts of Industry 4.0, the drivers and enablers of Industry 4.0 and its applications in the business world.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the Conceptual Framework of Industry 4.0 and describe the features of Smart and connected models	L1, L2	WK1 to WK4
CO2	Apply the concepts with the stress on maturity and readiness perspective and illustrate with a roadmap of technology	L1, L2, L3	WK1 to WK6
CO3	Explain the concept of Data analytics and describe its effect in the field of manufacturing and Internet of things	L1, L2	WK1 to WK4
CO4	Describe and apply the role of robotics in the effective implementation and success of Industry 4.0	L1, L2, L3	WK1 to WK6
CO5	Describe with applications of Industry 4.0 in the field of additive manufacturing and describe the use of this technique in improving productivity	L1, L2, L3,L4	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**A Conceptual Framework for Industry 4.0:** Introduction, Main Concepts and Components of Industry 4.0,State of Art, Proposed Framework for Industry 4.0, Supportive Technologies, Proposed Framework for Industry 4.0, Smart and Connected Product Business Models: Key Business Model Components of Smart and Connected Products, IoT Value Creation Layers and Technologies, Lean Production Systems for Industry 4.0, Automation Based Lean Production Applications, Maturity and Readiness Model for Industry 4.0 Strategy. *Self-Learning and Teamwork:* • Evolution of Industry 4.0	09	-
2	**Introduction, Existing Industry 4.0 Maturity and Readiness Models**: IMPULS: Industry 4.0 Readiness (2015), Industry 4.0/ Digital Operations Self-Assessment (2016), The Connected Enterprise Maturity Model (2016), Industry 4.0 Maturity Model (2016), Comparison of Existing Industry 4.0 Maturity and Readiness Models – Case Examples **Technology Roadmap for Industry 4.0:** Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, New Product and Process Development Phase Talent Development for Industry 4.0, Skill Requirements in the Digital World Talent Development Practices for Industry 4.0. *Self-Learning and Teamwork:* • Comparison of Existing Industry 4.0 Maturity and Readiness Models – Case Examples	09	-
3	**Data Analytics in Manufacturing:** Introduction, Literature Review, Power Consumption in Manufacturing, Estimation of Manufacturing Cost, Smart Remote Machinery Maintenance Systems with Komatsu. **Internet of Things and New Value Proposition:** Introduction, Internet of Things (IoTs), Examples for IoTs Value Creation in Different Industries, IoTs Value Creation Barriers: Standards, Security AI component: Role of AI-ML in Industry 4.0. *Self-Learning and Teamwork:* Examples for IOT's Value Creation in Different Industries	09	-

4	**Advances in Robotics in the Era of Industry 4.0:** Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics, Cognitive Architecture for Cyber- Physical Robotics, Industrial Robotic Applications, Human-Robot Collaborative Manufacturing, Cooperating Robots in Manufacturing, Assembly. **The Role of Augmented Reality in the Age of Industry4.0**, AR Hardware and Software Technology, Industrial Applications of AR, Discussion on applications. *Self-Learning and Teamwork:* • Recent Technological Components of Robots	09	-
5	**Additive Manufacturing Technologies and Applications:** Introduction, Additive Manufacturing (AM) Technologies, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing, Application Areas of Additive Manufacturing, Medical & Surgical applications, Impact of Additive Manufacturing Techniques on Society *Self-Learning and Teamwork:* • Impact of Additive Manufacturing Techniques on Society	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Industry 4.0: Managing the Digital Transformation, Alp Ustunda, Emre Cevikcan

Reference Books:

1. Industry 4.0 by Navya Yugachi Olakh, 2019 edition
2. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, January 2019

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105195/
2. https://drive.google.com/file/d/17CPu--DdQHwUGzcbjDdNZbEcvHQ56-Cf/view

Course Articulation:

POs → COs ↓	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		3			3	3					3	3	2	1
CO2	3		3	1		3	3					3	3	2	1
CO3	3		3			3	3					3	3	2	1
CO4	3		3	1		3	3					3	3	2	1
CO5	3		3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP723</td><td colspan="5">Course Title: Industrial Robotics</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC [Professional Elective Course-V]</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

- The concepts and classifications of robots and its benefits, the effective uses of sensors in effective functioning of robots with suitable illustration, numerical examples the controls to move the robots in multiple directions based on the Degrees of Freedom
- Analysis using mathematical tools the compositions of robots and its control
- The various algorithms for manufacture and control of robots with suitable rules of its movements

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO #	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the concepts and classifications of robots and its benefits	L1, L2	WK1 to WK4
CO2	Describe with applications the uses of sensors in effective functioning of robots with suitable illustration	L1, L2, L3	WK1 to WK6
CO3	Illustrate with numerical examples the controls to move the robots in multiple directions based on the Degrees of Freedom	L1, L2	WK1 to WK4
CO4	Effective analysis using mathematical tools the compositions of robots and its control	L1, L2, L3	WK1 to WK6
CO5	Apply various algorithms for manufacture and control of robots with suitable rules of its movements	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Basic Concepts:** Introduction, Applications, classification of robots, Degrees of freedom, Links-Joints-rigid body manipulator, various subsystems of robots, power sources: hydraulic, pneumatic, electric drives, Grippers. AI Component: Role of AI-ML in Robotics. *Self-Learning and Teamwork:* • Basic mechanisms used in robots	09	-
2	**Sensors:** Internal sensors: Position sensors, incremental encoder, absolute encoder, synchros and resolver, velocity sensors, acceleration and forces sensors, Touch sensors, proximity sensors, Range sensing, vision sensors. *Self-Learning and Teamwork:* • Characteristics of sensors.	09	-
3	**Transformation:** Rotation matrix, composite rotation matrix, Rotation matrix with Euler angles representation, homogenous transformation matrix, DH representation *Self-Learning and Teamwork:* • Basic transformation Principles	09	-
4	**Kinematics:** Direct and inverse kinematics, Forward position analysis, Inverse position analysis Jacobian matrix, Acceleration analysis. *Self-Learning and Teamwork:* • The robots - Velocity changes over time and Robot Dynamic behavioral study	09	-
5	**Motion planning:** Joint space planning - Cartesian space planning, Point-to- point Planning - continuous path generation. Collision avoidance algorithms. *Self-Learning and Teamwork:* • Simulation of motion Analysis	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Subir K Saha, Introduction to Robotics, 2008, Tata McGraw Hill
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, Robotics, 2008, Tata McGraw Hill

Reference Books:

1. Mikell P, Weiss G M , Nagel R N, Industrial Robotics, 1996, Mc GrawHill
2. Deb S R, Robotics Technology and flexible automation, 1992, John Wiley
3. Asfahl C. R, Robots and manufacturing automation, 1992, John Wiley
4. Klafter R D, Chimielewski T A, Robotic Engineering, 1994, PHI

Web Resources:

1. https://nptel.ac.in/courses/112105249

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP724</td><td colspan="5">Course Title: Data Analytics for Engineers</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td>Course Category:
PEC (Professional Elective Course-V)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

To understand the process of analyzing the statistical data and reporting the results in their projects using different software.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowled ge
CO1	Understand the classification of the construct measurement process and probability in engineering research.	L1, L2	WK1 to WK4
CO2	Demonstrate the Inferential Statistics, parametric and nonparametric tests in data analysis.	L1, L2, L3	WK1 to WK6
CO3	Understand and apply Multivariate data analysis and correlation analysis to real time data.	L1, L2, L3	WK1 to WK6
CO4	Understand and apply various methods in Regression analysis for real life problems	L1, L2, L3	WK1 to WK6
CO5	Apply Multivariate Statistical Analyses to solve various real life problems and interpret the results.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Data Analysis: Definition and classification of data, Types of Measurement of data, Reliability and validity of data, Measures of central tendency and dispersion. Probability, Conditional Probability, Different types of probability distributions: Binomial, Poisson and Normal Distribution, Selection of appropriate data analysis technique. *Self-Learning and Teamwork:* • Selection of appropriate Probability density function	**09**	**-**
2	Inferential statistics: Population and sample, Estimation, Hypothesis testing: Two tailed & one tailed Tests of Hypothesis, Standard Error of sampling distribution, Interpreting the p-value, Degrees of freedom, Types of Errors in Testing of Hypothesis. Parametric Tests: Z-test, t-test, Analysis of Variance (ANOVA), Non-parametric Tests: Chi-square test *Self-Learning and Teamwork:* • Implementing the ANOVA for Industry application to check the (Numerical) Hypothesis testing.	**09**	**-**
3	Multivariate Data Analysis: Approach to multivariate data analysis, Data quality check and improvement, Missing value treatment, Outlier treatment, Data reliability and normality checks, quantile – quantile and probability – probability plots, Kolmogorov – Smirnov (KS test), Model assumptions. Correlation Analysis: Variance, Covariance & Correlation, Pearson's Coefficient of Correlation *Self-Learning and Teamwork:* • Practical approach /study on Correlation Analysis	**09**	**-**
4	Regression Analysis: Dependent and Independent Variables, Categorization of Regression Analysis, Simple Linear Regression The multiple linear regression (MLR) model, R- squared, Adjusted R-squared, Standard errors, ANOVA in the regression model: T - tests in regression and respective p values: Multicollinearity and auto- correlations in regression. *Self-Learning and Teamwork:* • Real world Application of MLR	**09**	**-**

5	Multivariate Statistical Analyses: Conjoint analysis, Exploratory factor analysis, Cluster analysis, Multi-Dimensional Scaling, Structural Equation modelling, Confirmatory factor analysis, Common method bias issue in survey research, Common Method bias using unmeasured method factor, Mediation analysis using regression, Moderation analysis using regression, Moderated mediated analysis *Self-Learning and Teamwork:* Real world Application of Mediation and Moderation analysis.	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2013). Multivariate dataanalysis, 7/e. Pearson India.
2. Hayes, A. F. (2017). Introduction to mediation, moderation, and conditional process analysis:A regression-based approach. 2nd edition, Guilford Press. Reference Books:
3. Malhotra, N. K., & Birks, D. F. (2012). Marketing research: An applied approach. Pearson Education.6th edition.
4. Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). Business research methods. Cengage Learning.
5. Levin, R. I. (2011). Statistics for management. Pearson Education India.

SWAYAM/NPTEL:

1. https://onlinecourses.swayam2.ac.in/arp19_ap77/preview

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

Department: Industrial and Production Engineering						
Course Code: 24IP731		*Course Title:* *Maintenance Engineering & Industrial Safety*				
Total Credits: 03 L- 45: T-0 : P-0 : SL and TW-45		SDGs addressed: 4,9 & 12			*Course Category: PEC(* Professional Elective Course – VI)	Course Type: Theory
Teaching Learning Process		Total Contact hours/Semester	*Assessment in Weightage and marks*			
	Lecture	45		CIE	SEE	Total
	Tutorial	-	*Weightage %*	40	60	100
	Practical	-	*Maximum Marks*	40	60	100
	Self-Learning and Teamwork	45	*Minimum Marks*	20	25	45*
	Total	90				

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24) **COURSE**

PREREQUISITE: Nil

COURSE OBJECTIVES: Understand the importance of industrial maintenance & safety in factory set-ups / other industries to improve the efficiency and productivity of the organization.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the importance of industrial maintenance & safety in factory set-ups / other industries to improve the efficiency and productivity of the organization.	L1, L2	WK1 to WK4
CO2	Discuss the various planning measures to be taken in effective maintenance of machinery	L1, L2, L3	WK1 to WK6
CO3	Critically analyze the pollution effects and to know the measures to be taken up in pollution control	L1, L2	WK1 to WK4
CO4	Explain the various safety precaution guidelines to be studied and implemented	L1, L2, L3	WK1 to WK6
CO5	Critically examine the accident prone situations and critically think the counter measures to be taken	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Maintenance System:** Definition, Scope, Objective, functions and Importance of maintenance system, Type of maintenance system, Break down maintenance system, Preventive maintenance, Predictive maintenance, design out maintenance, corrective maintenance, planned maintenance, total productive maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance. *Self-Learning and Teamwork:* • Case studies on selection of methods like preventive or breakdown maintenance.	9	-
2	**Maintenance Planning:** Planning of maintenance junctures manpower allocation, Long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control. **Maintenance of Machinery:** Causes of machine failure, performance evaluation, complete overhauling of Machines tools. Maintenance planning and scheduling. Repair order control manpower requirement, Maintenance job analysis spare parts control. **AI Component:** Impact of AI-ML in Preventive/Predictive maintenance. *Self-Learning and Teamwork:* • Impact of Maintenance of Machinery - planning and scheduling in industry	9	
3	**Industrial Pollution Control**: Dust control – Fiber collectors, mechanical dust collectors, wet type collectors, Electrostatic precipitators, Noise pollution Control– Noise Measurement and control. Industrial vibration and its control, applications of IPC. **Introduction to Industrial Safety and Management**: History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, Role of management and role of Govt. in industrial safety. *Self-Learning and Teamwork:* • The significance of Industrial Pollution Control **[IPC]**	9	-
4	**Accident Preventions and Protective Equipment** Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Firefighting equipment, Accident reporting, Investigations. Industrial psychology in accident prevention, Safety trials. *Self-Learning and Teamwork:* • Industrial psychology in accident prevention- Case Studies	9	-

5	**Economic importance of accidents**, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety Standards for Mechanical equipment. **Safety Standards**: Safety standards for Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, welding, Plant housekeeping-building, Aisles, passages, floors, tool cribs, washrooms, canteens. Industry case examples. *Self-Learning and Teamwork:* • Case study on Analysis of accident records	**9**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Maintenance Engineering and Management - R.C.Mishra and K.Pathak, Prentice Hall of India.
2. Maintenance Engineering Hand book – Morrow, 3rd Edition.

Reference Books:

1. Hand book of Maintenance Management - Frank Herbaty.
2. Hand book of Industrial Engg & Management - W. Grant Lreson & Eugene L-Grant
3. Industrial Maintenance - H P Garg
4. Maintenance Engineering Hand book - Lindrey Higgins, McGraw Hill,
5. Plant Engineering Hand book – Staniar

Web Resources:

1. https://nptel.ac.in/courses/11 1 5 94
2. https://nptel.ac.in/courses/1121 5 4

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	1
CO3	3	3			3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low –1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP732</td><td colspan="5">Course Title: Energy Audit</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course – VI)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7"></td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td rowspan="2">Teaching Learning Process</td><td colspan="2">Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td rowspan="2">45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES:

1. To understand energy scenario and general aspects of energy audit, learn about methods and concept of energy audit and understand the energy utilization pattern including wastage and its management.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the basic concepts of energy audit and energy management	L1, L2	WK1 to WK4
CO2	Explain different types of energy audit, maximizing and optimizing system efficiency	L1, L2	WK1 to WK4
CO3	Summarize energy management systems, prepare and present energy audit report	L1, L2, L3	WK1 to WK6
CO4	Identify energy saving potential of thermal and electrical systems	L1, L2, L3	WK1 to WK6
CO5	Discuss Energy audit instruments, Procedures and Techniques.	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**General Aspects:** Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportunities, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies. *Self-Learning and Teamwork:* • Review of energy scenario in India • Real world application of SOLAR ENERGY	**09**	**-**
2	**Energy Audit Concepts:** Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements - Duties and responsibilities of energy auditors - Energy audit instruments - Procedures and Techniques. *Self-Learning and Teamwork:* • Case study on Need of Energy audit - Types of energy audit	**09**	**-**
3	**Principles and Objectives of Energy Management:** Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings. *Self-Learning and Teamwork:* • Need of Energy Management in Karnataka state	**09**	**-**
4	**Thermal Energy Management:** Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps – HVC Industries-Building Energy Management. *Self-Learning and Teamwork:* • Case study on Building Energy Management	**09**	**-**
5	**Electrical Energy Management:** Supply side Methods to minimize supply demand gap - Renovation and modernization of power plants - Reactive power management – HVDC - FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors *Self-Learning and Teamwork:* • Application on Energyefficient motors	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Murphy, W. R. (2007), Energy Management (1st edition), Elsevier India Private Limited.
2. De, B. K., (2010), Energy Management audit & Conservation, (2nd Edition), Vrinda Publication.

Reference Books:

1. Turner, W. C., Doty, S. and Truner, W. C., (2009), Energy Management Hand book, (7th edition), Fairmont Press.
2. L.C. Witte, P.S. Schmidt, D.R. Brown, (1988) Industrial Energy Management and Utilisation, (1st edition) Hemisphere Publication, Washington.
3. Elias P. Gyftopoulos, (1982) Industrial Energy Conservation Manuals, (1st edition) MIT Press.
4. Patrick, Patrick, Fardo (1993), Energy Conservation guide book, (1st edition) Prentice hall.

Web/Digital resources:

1. https://beeindia.gov.in/content/energy-auditors

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/112105221

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3	1		3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP733</td><td colspan="5">Course Title: Engineering Systems Design</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC(Professional Elective Course – VI)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td>Practical</td><td>-</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: -Nil-

COURSE OBJECTIVES: Upon completion of the course, students will acquire a profound understanding of engineering design principles, developing the ability to creatively solve design problems, evaluate economic aspects, optimize solutions, ensure reliability, and consider human factors. They will be equipped to navigate the entire design process, from conception to implementation, in a comprehensive and effective manner.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Demonstrate an understanding of the design process, morphology of design, and apply a systems approach to engineering problems	L1, L2	WK1 to WK4
CO2	Analyze mechanical design languages, differentiate abstract and concrete representation, and apply human information processing models to design	L1, L2, L3	WK1 to WK6
CO3	Exhibit creativity in solving design problems, applying tools like morphological analysis, fishbone diagrams, and design by analogy with demonstrated proficiency	L1, L2	WK1 to WK4
CO4	Exhibit creativity in solving design problems, applying tools like morphological analysis, fishbone diagrams, and design by analogy with demonstrated proficiency	L1, L2, L3	WK1 to WK6
CO5	Assess the reliability of assembled systems, evaluate the impact of human factors on design, and apply this understanding to make informed design decisions.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** What is Designing? Early Man as a Designer; Design by evolution; Examples; Inadequacy of Evolutionary Method in Modern Design Situation; Systems Approach to Engineering Problems. The Design Process: The Structure of the Design Process; Morphology of Design; Design Process-Decision Making and Iteration. Realization of Need; preliminary Need Statement; Analysis of Need Specifications; standards of Performance; Environmental factors; Resources and Constraints; Examples. *Self-Learning and Teamwork:* • Design requirement analysis	09	-
2	**Design abstraction and representation**: Mechanical Design Languages and, Abstraction; Case example of abstract and concrete representation, cognition process during the design Human information processing models and types of system knowledge – general, domain specific and procedural knowledge with case examples. *Self-Learning and Teamwork:* • Case example of abstract and concrete representation	09	-
3	**Origination of Design Concepts and problem-solving tools:** Solving the Design Problem- Creativity; The Creative Attitude; The Creative Process; Mental Fixity; Creativity by Analogy with Systems; Use of Check Lists. Strategies for Search for Design Concepts; Morphological Analysis; Fish bone diagrams, brainstorming; Synectics; Design by analogy- Examples to Demonstrate the use of Each Technique. *Self-Learning and Teamwork:* • Applications of IDEATION Tools	09	-
4	**Economics, Optimization and Reliability in Engineering Design (No Numerical Problems):** Place of Economics in Design; Feasibility analysis The Quality of Design; The concept of utility; Using Utility for Design Selection **Development of Design:** From Concept to Product; Designing for Function; Designing for Production, designing for Shipping, Handling; and Installing; Designing for Use; Designing for Maintenance; Compatibility Analysis; The Detailed Design. *Self-Learning and Teamwork:* • Basic criteria to be considered for Development of Design	09	-
5	**Reliability and Human Factors in Design:** Introduction; A Measure of Reliability; Reliability of Assembled Systems – Series, Parallel, and their Combination; **Man Machine Interface**; Design of displays and controls - Displays and controls; factors influencing the Design of controls and displays with case examples. *Self-Learning and Teamwork:* • Design of controls and displays with case examples. • Ergonomic factors considered for Design.	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books

1. An introduction to engineering Design Methods- Vijay Gupta and P.N. Murthy; Tata Mc Graw Hill Publishing company Limited. 1997.
2. The Creative Problem Solver's Tool box – A complete Course in the Art of Creating Solutions to Problems of any kind Richard Fobes, , University Press, 1999.

REFERENCE BOOK:

1. How to be better at Creativity? The industrial Society. Master mind book -Geoffrey Petty; Indian edition, 1998

Web Resources:

1. https://nptel.ac.in/courses/112105048
2. https://onlinecourses.nptel.ac.in/noc21_mg39/preview

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	1		3	3					3	3	2	
CO3	3	3			3	3					3	3	2	1
CO4	3	3	1		3	3					3	3	2	1
CO5	3	3	1		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP734</td><td colspan="5">Course Title: Management Information Systems</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC (Professional Elective Course – VI)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: NIL

Course Objective: Students will learn different information systems and technology used in a business analysis and understands different decision support systems

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles MIS and Business operations	L1, L2	WK1 to WK4
CO2	Discuss the concept of E Business and model followed by the industry with suitable industry examples	L1, L2, L3	WK1 to WK6
CO3	Describe the WWW Architecture with suitable white paper examples	L1, L2, L3	WK1 to WK6
CO4	Critically analyze the Consumer Oriented E Commerce to optimize the various functions of industry for the smooth functioning of the organization	L1, L2, L3	WK1 to WK6
CO5	Analyze the various Data Interchange Models with its roles & responsibilities	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content/Syllabus

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Fundamentals of Information Systems:** Information systems in business, fundamentals of information systems, solving business problems with information systems. **Information Systems for Business Operations:** Business information systems, Transaction processing systems, management information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology. *Self-Learning and Teamwork:* • Applications and issues in information technology.	09	-
2	**Introduction** to **E-Business:** E-commerce frame work, Media convergence, Consumer applications, Organization applications. **E-Business Model:** Architectural frame work for E-commerce, Application services and transaction Models –B2C Transactions, B2B Transactions, and Intra – Organizational Transactions. *Self-Learning and Teamwork:* • Real life case study on E-Business Model	09	-
3	**WWW - Architecture:** Client server structure of the web, e-commerce architecture, technology behind the web. *Self-Learning and Teamwork:* • WEB Browser as front end	09	-
4	**Consumer –Oriented E-Commerce:** Consumer Oriented Application-Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumer perspective, Merchants perspective. *Self-Learning and Teamwork:* • Emphasis on Digital Marketing for B2C Business	09	-
5	**Electronic Data Interchange (EDI):** EDI Concepts, Applications in business- Components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing Using EDI, Digital Signature and EDI. *Self-Learning and Teamwork:* Case studies of EDI Concepts in retail , Health care , Supply Chain	09	-

** NOTE: SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. Management Information systems- managing information technology in the internet worked Jams. A O'Brien Tata McGraw Hill publishing company limited 2002
2. Management Information Systems Laaudon & Laudo PHI ISBN 81-203-1282

Reference Books:

1. Management Information Systems: S. Sadagopan PHI 1998 ISBN 81-203-1180-9
2. Information Systems Form Modern management- G.R. Mudrick PHI 2nd Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_mg60/preview
2. https://nptel.ac.in/courses/122105022

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP74P</td><td colspan="5">Course Title: Industrial Training/Internship</td></tr>
<tr><td colspan="3">Total Credits: 02
L- 0: T- 0: P-30 : SL and TW-30</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PWC</td><td colspan="2">Course Type: Project work Course</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>-</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td colspan="2" rowspan="2">100</td></tr>
<tr><td>Practical</td><td>30</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>30</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>60</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisites: Nil

Course Objective: To undergo industrial training / internship from industry or present a technical seminar

Course Outcomes: After completing this course, students should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand and apply the knowledge of writing the technical reports by using a word processor and presenting the finding using presentation software such as Microsoft power point.	L1, L2,L3,L4	WK1 to WK4 and WK9
CO2	Learn new technology or knowledge from industry or apply the knowledge of subject domain to industrial scenario or come up with suggestion for the improvement of current technology	L1, L2, L3,L4	WK1 to WK4 and WK9

Course Content/Syllabus

Unit No.	Course Content	No. of Hours
1	Guidelines: • Each student shall undergo an industrial training for a duration of four weeks. ▪ The dates for training are as per the calendar of events announced by the university, in the vacation between 4th and 6th semesters or 6th and 7th semesters. ▪ During the training period, the student will learn work ethics, communication / managerial skills/ Engineering skills and application skills in practice and collect useful information required for preparing the report and presentations. ▪ The student will report to the department at the end of the training period, submit the hard copy of internship report with the company issued completion certificate. ▪ The student will be required to make a comprehensive report on the work done during the industrial training and make a presentation of the same as per the time fixed by the department. ▪ The evaluation committee as identified by the Head of the Department will evaluate the performance of the student.	30

References:

1. Peer reviewed reputed journals.
2. Industry Reports
3. Company Handbooks and reference materials.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP75P</td><td colspan="6">Course Title: Project Work Phase I</td></tr>
<tr><td colspan="2">Total Credits: 02
L- 0: T- 0: P-30 : SL and TW-30</td><td colspan="3">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PWC</td><td>Course Type: Project work Course</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>-</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>30</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>30</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>60</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: Nil

Course Objective: To come up with ideas for potential final year project in emerging areas of Design, Production, Thermal and Management Streams.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the importance of literature review and finding the gap in literature to find the new solution for identified project.	L1, L2, L3, L4	WK1 to WK4 and WK9
CO2	Apply the knowledge of subject domain to develop new ideas and propose the feasibility of ideas which can be realized as a design/product/service/theory.	L1, L2, L3, L4	WK1 to WK4 and WK9

Course Content/Syllabus

Unit No.	Course Content	No. of Hours
1	➢ The students are required to make project batches and should choose the field within I&PE domain and identify their potential projects for final year. ➢ They should carry out preliminary survey and carry out extensive literature survey during the first phase. ➢ A total of 3 presentations must be done during the course of the semester and the progress report has to be submitted in each seminar. ➢ A technical report should be submitted indicating the Introduction, objective, Literature survey, Current Status, Proposed work. ➢ All the guides involved in the project have to be present for these seminars.	30

References:

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1. Peer reviewed reputed journals.
2. Project reports of previous years.
3. Project style guides for report writing

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	1
CO2	3	3	3		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP811</td><td colspan="5">Course Title: Operations Management</td></tr>
<tr><td colspan="3">Total Credits: 03
45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC (Professional Elective Course-VII)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Maximum Marks</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
<tr><td colspan="2"></td><td></td><td>Minimum Marks</td><td>20</td><td>25</td><td>45*</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: To get acquainted with the basic aspects of production management and expose the students to various aspects of planning, organizing and controlling operations management and to understand different operational issues in manufacturing and learn different problem solving methodologies and production management techniques.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Understand the fundamental concepts of operations management with emphasis on System Design, Capacity Planning and Decision making methodologies used in Manufacturing and Service organizations.	L1, L2, L3	WK1 to WK6
CO2	Understand and apply the knowledge forecasting, aggregate planning and master scheduling techniques for various cases.	L1, L2, L3	WK1 to WK6
CO3	Apply the knowledge of MRP, CRP and recognize the importance of controlling production activities in Organizations	L1, L2, L3	WK1 to WK6
CO4	Understand the various scheduling techniques and apply the same for typical cases encountered in Industrial environments.	L1, L2, L3	WK1 to WK6
CO5	Understand and apply the knowledge of OM concepts applied to different situations faced in service organizations.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Operations Management**: Concepts: Introduction, Historical development, The trend: Information and Nonmanufacturing systems, Concept of productivity and its dimensions. **System Design, Capacity Planning and Decision Making:** Introduction, management as a science, characteristics of decisions, framework for decision making, decision methodology, decision support systems economics models, statistical models, Manufacturing and service systems, design and systems capacity and capacity planning *Self-Learning and Teamwork:* • Case studies on Measure of productivity in Industries	**09**	**-**
2	**Demand Forecasting:** Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, and Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of Forecasts. AI Component: AI based forecasting algorithms and applications. *Self-Learning and Teamwork:* • The concepts of Demand forecasting in Industry	**09**	**-**
3	**Material and Capacity Requirements Planning:** Overview: MRP and CRP, Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. Controlling Production Activities: PAC, objectives and data requirements, scheduling strategy and guidelines, scheduling methodology, priority control, capacity control. **Scheduling:** Concepts - measures of performance, SPT rule, weighted SPT rule, EDD rule, minimizing the number of tardy jobs. **Flow-Shop Scheduling:** Introduction, Johnson's rule for 'n' jobs on 2 and 3machines, CDS heuristics. **Job- Shop Scheduling:** Types of schedules, scheduling 2 jobs on 'm' machines *Self-Learning and Teamwork:* • Case study on Capacity management	**09**	**-**
4	**Aggregate Planning and Master Scheduling:** Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods *Self-Learning and Teamwork:* • Case study on Master scheduling methods	**09**	**-**

5	**Service Operations Management:** Nature and Characteristics, Classification of services and analyzing service operations, Service system design and delivery process, Technology &automation in services. **Service Capacity Management**, Service Inventory and Supply Chain Management, Quantitative Models in Managing Service Operations – Application of simulation in service operations management. *Self-Learning and Teamwork:* • Simulation-Based Strategies for Managing Service Operations	**09**	**-**

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

T**ext Books:**

1. Operations Management- Monks, J.G., McGraw-Hill International Editions
2. Production and Operations Management- Panner selvam. R, PHI.
3. Productions & operations management - Adam & bert. PHI

Reference Books:

1. Modern Production/Operations Management- Buffa, Wiely Eastern Ltd.,
2. Production and Operations Management- Chary, S.N, Tata-McGraw Hill.,
3. Operations management - James Dilworth. PHI,
4. Operations Management – Lee J Karjewski and Larry P Ritzman, strategy and Analysis, Pearson Education.

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/112107238
2. https://nptel.ac.in/courses/110107141

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2								3	3	2	1
CO2	3	3	2								3	3	2	1
CO3	3	3	2								3	3	2	1
CO4	3	3	2								3	3	2	1
CO5	3	3	2								3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="3">Course Code: 24IP812</td><td colspan="5">Course Title: Human Resource Management</td></tr>
<tr><td colspan="3">Total Credits: 03
L- 45: T- 0: P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category:
PEC (Professional Elective Course-VII)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td colspan="2"></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td colspan="2">Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td colspan="2">Tutorial</td><td>-</td><td rowspan="2">Weightage %</td><td rowspan="2">40</td><td rowspan="2">60</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">Practical</td><td>-</td></tr>
<tr><td colspan="2">Self-Learning and Teamwork</td><td rowspan="2">45</td><td rowspan="3">Minimum Marks</td><td rowspan="3">20</td><td rowspan="3">25</td><td rowspan="3">45*</td></tr>
<tr><td colspan="2">Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

Pre-requisite: NIL

Course Objective: The topic covers the need for planning, recruitment, training, appraisal and motivational aspects to be addressed to in order to effectively manage the organization. To know industrial laws to start and manage a company/industry.

Course Outcomes: After completing this course, students should be able to:

CO #	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	Explain the General principles of Human Resources & Planning and review the learning mechanism	L1, L2	WK1 to WK4
CO2	Discuss the salient features of Recruitments and the procedures to be followed in selection with case examples	L1, L2, L3	WK1 to WK6
CO3	Describe the Models of Motivation and its effectiveness in enhancing the productivity and performance with suitable case examples and appraisals	L1, L2, L3	WK1 to WK6
CO4	Critically analyze H R Audit and accounting with other financial criteria with suitable illustrative examples	L1, L2, L3	WK1 to WK6
CO5	Analyze the various Industrial Laws for the effective implementation on the workers and environment with examples	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Overview, Objectives, competitive advantage, skills required. H.R.Policies, conceptual framework, methodologies **Human Resource Planning:** Integrated strategic planning and human resources planning HRP at different levels, Process of HRP, Control and review mechanism. *Self-Learning and Teamwork:* • Case Study on Human resources planning [HRP] at different levels	**09**	--
2	**Recruitment:** Need, Sources and techniques of recruitment assessment of recruitment programs Selection, Placement and Induction: Meaning, Significance factors affecting decisions, procedure, concept of testing, Interviews, Placement and induction process Training the work force: Importance, scope, training verses development, training process, techniques - Career Management - Planning and Development. *Self-Learning and Teamwork:* • Case Study on Training versus Development, Training process.	**09**	--
3	**Leading:** Motivation – Human factors in managing, Motivation and Motivators, The hierarchy of needs theory, Theory X and Theory Y, The Motivation-Hygiene theory, Immaturity-Maturity theory, A systems and contingency approach to Motivation, Situational, or Contingency, approach to leadership. **Performance Appraisal:** Meaning, need, purpose, content, legalities of performance appraisal. Methods of performance appraisal – traditional, graphic rating scales, ranking, paired comparison, forced distribution, checklist and Modern Scales of performance appraisal. *Self-Learning and Teamwork:* • Case study on Modern Scales of performance appraisal.	**09**	--
4	**HR Audit:** HR accounting, absenteeism, labour turnover, separations, promotion, transfer, research in HRM, HR records, importance of HRIS, management of knowledge workers - HRM in future, International HRM. **Compensations Management:** Concept and Theories of wage machinery, Benchmarking– Performance linked compensation system – statutory requirement in compensation Management. *Self-Learning and Teamwork:* • Practical approach on Importance of HRIS	**09**	--

5	**Industrial Safety and Welfare:** **The Factories Act 1948:** Health, safety and welfare - hours of work - holidays and leave with pay - employment of women and children inspection and regulation. **The Industrial Disputes Act 1947**: The Industrial Employment (Standing Orders) Act1946, The Payment of Wages Act 1936 *Self-Learning and Teamwork:* • Case study on Current Act and The Industrial Employment (Standing Orders) Act1946	**09**	--

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Books:

1. P. Subba Rao, Human Resource Management and Industrial Relations Himalaya Publishing House
2. Human resource and personnel management by K. Aswathappa.
3. C.B. Memoria, —Personnel Management Himalaya Publishing

Reference Books:

1. Dessler, Gary, Human Resources Management, New Delhi: Prentice Hall of India Pvt. Ltd.
2. Saiyadain, Mirza S., Human Resource Management, New Delhi:TMH,.
3. San Beardwell and Len Holden, Human Resource Management, New Delhi: Macmillan,
4. Nair ,N.G. and Latha Nair, Personnel Management and Industrial Relations, NewDelhi: S.Chand & Co.
5. Peter C.Cairo,—Counselling in Industry–Personnel Psychology
6. Wayne F Cascio, —Management Human Resources TATA Mc Graw Hill New Delhi.
7. H.John Bernardino, and Joyce E.A Russel, —Human Resource Management, McGraw Hill International Editions.

Web Resources:

1. https://archive.nptel.ac.in/courses/110/105/110105069/
2. https://onlinecourses.nptel.ac.in/noc19_mg51/preview

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3	2		3	3					3	3	2	1
CO3	3	3	2		3	3					3	3	2	1
CO4	3	3	2		3	3					3	3	2	1
CO5	3	3	2		3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="7">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP813</td><td colspan="5">Course Title: Additive Manufacturing</td></tr>
<tr><td colspan="2">Total Credits: 03
L- 45: T-0 : P-0 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="2">Course Category: PEC (Professional Elective Course-VII)</td><td>Course Type: Theory</td></tr>
<tr><td rowspan="7">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="4">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>45</td><td></td><td>CIE</td><td>SEE</td><td>Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>Maximum Marks</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td rowspan="2">45*</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: NIL.

COURSE OBJECTIVES: To introduce students basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques, and appreciate the difference between subtractive manufacturing and additive manufacturing, learn the concept of joining of materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodology.

Course Outcomes: After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working ng Knowledge
CO1	Understand the importance of prototyping concepts with emphasis on Rapid manufacturing processes, and role of additive manufacturing in product development.	L1, L2	WK1 to WK4
CO2	Analyze the techniques of Liquid and Solid based Additive Manufacturing Systems and its applications in various domains.	L1, L2	WK1 to WK4
CO3	Apply Rapid Tooling and Additive manufacturing in range of domains from engineering and other fields.	L1, L2, L3	WK1 to WK6
CO4	Understand the concepts of Reverse Engineering and different types of STL format	L1, L2	WK1 to WK4
CO5	Illustrate the Application of Additive Manufacturing	L1, L2	WK1 to WK4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), and classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process. **Overview of additive manufacturing**– History – Need- Classification - Additive Manufacturing Technology in Product Development- Materials for Additive Manufacturing Technology – Tooling – Applications *Self-Learning and Teamwork:* • Refine Ideas for Traditional Prototyping Vs. Rapid Prototyping(RP)	09	-
2	**Liquid based additive Manufacturing systems:** Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, **Solid based AM Systems:** Laminated Object Manufacturing (LOM): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. *Self-Learning and Teamwork:* • Segmenting Liquid-Based Manufacturing Systems for Industrial Applications	09	-
3	**Powder based Additive manufacturing and 3d printing systems:** Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three-Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting. **Multi Jet Modelling (MJM):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. *Self-Learning and Teamwork:* • Industry application of Powder based Additive manufacturing and 3d printing systems	09	-
4	**AM & Reverse Engineering:** Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology, concept of Reverse Engineering, nature and characteristics. **AM Data formats: Reengineering for digital representation:** STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs. AM Software 's: Need for AM software, Features of various AM software. *Self-Learning and Teamwork:* • Real world application of Reverse Engineering- its Basic concepts	09	-

5	**Rapid Tooling:** conventional tooling vs RT, need for RT. Rapid tooling classification**,** Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Kel tool process **AM applications:** Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture *Self-Learning and Teamwork:* • Industry application of 3D Kel tool process	09	-

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Text Book:

1. Chua C.K., Leong K.F., and Lim C.S., —Rapid prototyping: Principles and applications, Third Edition, World Scientific Publishers.
2. GebhardtA — Rapid prototyping, Hanser Gardener Publications.

Reference Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, Springer, Brent Stucker, David W. Rosen, and IanGibson,
2. Liou L.W. and Liou F.W., —Rapid Proto typing and Engineering applications: A toolbox for prototype development, CRC Press
3. KamraniA.K. and Nasr E.A., —Rapid Prototyping: Theory and practice, Springer, 2 6.

Web Resources:

1. https://nptel.ac.in/courses/1121 33 6 Course

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3					3	3	2	1
CO2	3	3			3	3					3	3	2	1
CO3	3	3	1		3	3					3	3	2	1
CO4	3	3			3	3					3	3	2	1
CO5	3	3			3	3					3	3	2	1

High – 3, Medium – 2, Low – 1

<table>
<tr><td colspan="8">Department: Industrial and Production Engineering</td></tr>
<tr><td colspan="2">Course Code: 24IP82P</td><td colspan="6">Course Title: Project Work Phase-II</td></tr>
<tr><td colspan="2">Total Credits: 10
L- 0: T- 0: P-150 : SL and TW-45</td><td colspan="2">SDGs addressed: 4,9 & 12</td><td colspan="3">Course Category:
PWC</td><td>Course Type: Project work course</td></tr>
<tr><td rowspan="6">Teaching Learning Process</td><td></td><td>Total Contact hours/Semester</td><td colspan="5">Assessment in Weightage and marks</td></tr>
<tr><td>Lecture</td><td>-</td><td></td><td>CIE</td><td>SEE</td><td colspan="2">Total</td></tr>
<tr><td>Tutorial</td><td>-</td><td>Weightage %</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Practical</td><td>150</td><td>Maximum Marks</td><td>40</td><td>60</td><td colspan="2">100</td></tr>
<tr><td>Self-Learning and Teamwork</td><td>45</td><td rowspan="2">Minimum Marks</td><td rowspan="2">20</td><td rowspan="2">25</td><td colspan="2" rowspan="2">45*</td></tr>
<tr><td>Total</td><td>195</td></tr>
</table>

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 23+ 22 or 24 + 21)

{The marks for project is calculated [70:30 ratio]}

Course Objective:

1. To carry out real time projects in emerging areas of Design, Production, Thermal and Management Streams
2. To convert ideas into realizable solution in the identified areas of I&PE domain
3. To find or propose solutions for existing problems identified in the Manufacturing/Service or in social scenarios.

COURSE OUTCOME:

CO#	Course Outcomes	Highest Level of Cognitive Domain	Working Knowledge
CO1	**Apply theoretical knowledge to real-world problems** Learners will demonstrate the ability to integrate domain-specific concepts and tools to design, develop, and implement solutions for practical challenges.	L1, L2 ,L3	WK1 to WK6
CO2	**Develop teamwork and project management skills** Students will collaborate effectively in teams, manage project timelines, allocate resources, and communicate progress through structured documentation and presentations.	L1, L2 ,L3	WK1 to WK6
CO3	**Enhance critical thinking and innovation** Learners will analyze complex problems, explore alternative approaches, and propose innovative solutions using research, experimentation, and iterative design.	L1, L2, L3	WK1 to WK6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus

Unit No	Description	No of Hours
01	➢ Students should identify the thrust areas of I&PE domain and must carry out a group project. ➢ The student batches should be formed during 7th semester. ➢ Thorough literature review should be conducted to narrow down the project topic during 7th and 8th Semester break. ➢ Projects can be carried out either in the industries/organizations with proper permission from the respective guide(s) and HOD. ➢ A total of 3 presentations in 3 different phases must be done during the semester and the progress reports with PPT -PRESENTATION has to be submitted to the department. *Self-Learning and Teamwork:* Read Case Studies and Research Papers • Study successful projects in your domain to understand methodologies and outcomes. • Use platforms like **Google Scholar**, **ResearchGate**, or **IEEE Xplore**. • Analyze how problems were framed and solved.	150

** NOTE : SELF LEARNING – TEAM WORK –[SL and TW-45 hrs] is only considered for CIE – INTERNAL ASSESSMENT not for SEE –SEMESTER END EXAMS

Phase – I report should include:

1. Problem definition and Problem statement.
2. Objective and Scope of the proposed Project work.
3. Methodology of proposed Project work.
4. Literature review and references.

Phase-II report should include:

1. Work completed till date.
2. Work in progress.
3. Future work to be carried out.

Phase-III report should include: Detailed report of the project work

1. Based on the area of work, students should submit: Material specimen (if any), Design Prototype (if any), Layout design drawings (if any), related graphs, charts etc. and other outcome on the day of evaluation.

References: Project Report Guidelines Prepared by I&PE Department.

***Note: Students should refer to Peer reviewed journals for citing source and for literature review.

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		3	3					3	3	2	2
CO2	3	3	3		3	3					3	3	2	2
CO3	3	3	3		3	3					3	3	2	2

High – 3, Medium – 2, Low – 1

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