SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree

In

Industrial and Production Engineering

V & VI Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph: 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

PES College of Engineering

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
- Promote research, product development and industry-institution interaction.

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

The Department of Industrial & Production Engineering was started during the year 1982 with a mission to produce the students of good management skill to cater the need of the advanced and globalized market which demand quality management people. The long journey of 39 years has seen satisfactory contributions to the society, nation and world. The alumni of this department has strong global presence making their alma mater proud in every sector they represent. The Department is having with qualified and dedicated faculties in various production and ergonomics discipline. The quality of teaching and training has yielded high growth rate of placement at various organizations. The faculty of the Department not only engage in teaching, also carry out research and have successfully supervise number of research scholars to get their Doctoral degrees.

Vision

"Contribute to achieve and pursue **academic excellence** for imparting **quality education** in I & P Engineering and to carry out the **research activity** on continuous basis to develop **competent and social responsible** engineers and managers."

The Department of Industrial and Production Engineering is committed to

- **M1:** To educate them in the fundamental concept, knowledge, skills in theory and practices.
- **M2:** To prepare them through skilled programmes for better Employment as engineers and Managers or pursuit of advanced degrees in Industrial, Production and Mechanical Engineering fields.
- **M3:** To inculcate qualities of communication skills, professional personality and ethical values to Make them the responsible and competent professionals.

Program Educational Objectives (PEOs)

- **PEO1:** Industrial and Production Engineering program will prepare graduates who will have the ability to apply the principles and techniques of traditional and modern quantitative, qualitative analysis, synthesis and effectively interpret, evaluate, select, and communicate the desired alternative in both manufacturing and service industries.
- **PEO2:** Industrial and Production Engineering program will prepare its graduates who will possess the required engineering competence in industrial engineering, production engineering and managerial skills.
- **PEO3:** Industrial and Production Engineering program will prepare graduates, who possess communication skills, professional personality and ethical values as responsible and competent entrepreneur and professionals.

Program Outcomes (POs)

The department adopted the POs specified by the NBA in the Annexure-1 of the format provided in the SAR application. The graduates of the program will be able to exhibit their skills and knowledge as per the POs.

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Industrial and Production Engineering Graduates will be able to

- **PSO1:** Industrial & Production engineering graduates will be able to apply the knowledge acquired in the program about materials and finishing process
- **PSO2:** Industrial & Production engineering graduates will be able to design product based on Ergonomic Principles

Bachelor of Engineering (V –Semester)											
Sl. No	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21IP501	Management and Entrepreneurship	IP	3	-	-	-	3	50	50	100
2	P21IP502	Professional Core Course- Design of Machine Elements	IP	3	-	-	-	3	50	50	100
3	P21IP503	Professional Core Course (Elective)- I	IP	3	-	-	-	3	50	50	100
4	P21IP504	Professional Core Course (Integrated)- Work Study and Ergonomics – IE Laboratory	IP	3	-	2	-	4	50	50	100
5	P21IPO505X	Open Elective – I	IP	3	-	-	-	3	50	50	100
6	P21IPL506	Professional Core Course Laboratory- Advanced Geometric Modelling Laboratory	IP	-	-	2	-	1	50	50	100
7	P21INT507	Internship – II	IP	-	-	-	-	2	-	100	100
8	P21HSMC508	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV509	Social Connect and Responsibility	IP	1	-	-	-	1	100	-	100
	Total							**21**			

Professional Core Course – Elective - I			**Open Elective - I**	
Sl.No	**Course Code**	**Course title**	**Course Code**	**Course title**
1	P21IP5031	Composite Materials	P21IPO5051	Principles of Marketing
2	P21IP5032	Industrial Robotics	P21IPO5052	Control Engineering and M/C Tool Drive
3	P21IP5033	Computer Integrated Manufacturing	P21IPO5053	World Class Manufacturing
4	P21IP5034	Modern Machining Methods	P21IPO5054	Plant Layout and Design

	Bachelor of Engineering (VI –Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**Pr**		**CIE**	**SEE**	**Total**
1	P21IP601	Professional Core Course- Quality Assurance and Reliability	IP	3	-	-	-	3	50	50	100
2	P21IP602	Professional Core Course (Elective)-II	IP	3	-	-	-	3	50	50	100
3	P21IP603	Professional Core Course (Elective)- III	IP	3	-	-	-	3	50	50	100
4	P21IP604	Professional Core Course (Integrated)- CAD/CAM - CNC Laboratory	IP	3	-	2	-	4	50	50	100
5	P21IPO605X	Open Elective – II	IP	3	-	-	-	3	50	50	100
6	P21IPL606	Professional Core Course Laboratory- Computer Aided Analysis Laboratory	IP	-	-	2	-	1	50	50	100
7	P21IPMP607	Mini – Project	IP	-	-	2	2	2	50	50	100
8	P21HSMC608	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV609	Universal Human Values and Professional Ethics	IP	1	-	-	-	1	50	50	100
	Total							**21**			

Professional Core Course – Elective-II			**Professional Core Course – Elective-III**		**Open Elective-II**	
Sl. No	**Course Code**	**Course title**	**Course Code**	**Course title**	**Course Code**	**Course title**
1	P21IP6021	Operations Management	P21IP6031	Engineering Economics	P21IPO6051	Just In Time Manufacturing
2	P21IP6022	Product Design and Manufacturing	P21IP6032	Cellular Manufacturing	P21IPO6052	Flexible Manufacturing System
3	P21IP6023	Materials Management	P21IP6033	Nanotechnology	P21IPO6053	Project Management
4	P21IP6024	Theory of Metal Forming	P21IP6034	Theory of Metal Cutting	P21IPO6054	Production Planning & Control.

MANAGEMENT AND ENTREPRENEURSHIP [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP501**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain the Nature, Characteristics, Level and Scope of Management.
- Explain the concept of planning, organizing, directing, Motivating and controlling of workers in the organization.
- Describe the concept of entrepreneurship, types of entrepreneur and role of entrepreneur in economic development.
- Summarize the steps involved to start a small scale industry (SSI) and the role of supporting agencies to start the SSI.
- Identify the business opportunities in the market, and importance of ownership in an industry.

UNIT – I	**Management**	**8 Hours**

Management: Introduction – Meaning – Nature and characteristics of Management, Scope and functional areas of management – Management as a science, Art or profession – Management and administration – Roles of management, Levels of management, development of management thought –early management approaches – modern management approaches.

Self-study component:	Social Responsibility of Manager.

UNIT – II	**Planning, Organizing and Staffing**	**8 Hours**

Planning: Nature, purpose of planning process– objectives - Types of plans (Meaning only) - Decision making —Hierarchy of plans.

Organizing: Nature and purpose of organization, principles of Organizations – Types of organization.

Staffing: Nature and importance of Staffing – Process of selection and recruitment (in brief).

Self-study component:	Importance of planning process, MBO and MBE (Meaning only).

UNIT – III	**Directing, Controlling and Entrepreneur**	**8 Hours**

Directing: Meaning and nature of directing – Leadership styles and motivation theories, communication – Meaning and importance – Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling – Methods of establishing control (in brief).

Entrepreneur: Meaning of Entrepreneur, Types of Entrepreneur, Women Entrepreneurs, Steps to be taken to develop women entrepreneurship**.**

Self-study component:	Essentials of a sound control system, Roles of women Entrepreneurs in Economic Development.

UNIT – IV	**Small Scale Industry**	**8 Hours**

Small Scale Industry: Definition; Characteristics; Objectives: Advantages of SSI. Steps to start an SSI – Government Support for SSI during 5 year plans, Effect of WTO/GATT.

Institutional Support: Different Schemes; TECKSOK; KSSIDC; KSIMC; DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC.

Self-study component:	Ancillary Industry and Tiny Industry, KIADB Role for SSI.

UNIT – V	Preparation Of Project	8 Hours

Preparation Of Project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report, Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Self-study component:	Contents and Specimen of a project Report.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Define the meaning, nature, levels and characteristics of management.	Remember	L2
CO2	Describes the nature, types, purpose of planning and taking decision under different conditions, and defines the different organization structures and staffing policies and Procedures.	Understanding	L3
CO3	Demonstrate the motivation, leadership theories and communication process model and Define the entrepreneurship concept, process and barriers in entrepreneurship.	Understanding	L3
CO4	Explain the Institutional supports given by the government to start Small Scale Industry.	Remember	L2
CO5	Recognize the guide lines to be followed for writing the project report, and to survey the market.	Applying	L2

Text Book(s):

1. **Principles of Management** – P.C. Tripathi, P.N. Reddy; Tata McGraw Hill, 5th Edition
2. **Management and Entrepreneurship** – N. V. R. Naidu & T. Krishna Rao, I. K. International, New Delhi – 2015, ISBN 978-81-906757-8-9

Reference Book(s):

1. **Entrepreneurship Development** – S S Khanka – S Chand & Co.
2. **Management** – Stephen Robbins – Pearson Education, PHI -17th Edition.
3. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai–Himalaya Publishing House

Web and Video link(s):

1. https://www.youtube.com/watch?v=MdNNGfoxrqA
2. https://www.youtube.com/watch?v=eiGeV-tEFzI&list=PL5xGAxdWjIsCgPNjfzanLsjIZlckx86fF

E-Books/Resources:

1. https://www.azdocuments.in/2020/09/management-and-entrepreneurship-for-it.html

DESIGN OF MACHINE ELEMENTS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP502**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

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

UNIT – I	**Design for Static Strength**	**8 Hours**

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. Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor.

Self-study component:	Members subjected to Bi-axial stresses.

UNIT – II	**Design for Fatigue Strength**	**8 Hours**

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-study component:	Impact load due to axial loading.

UNIT – III	**Mechanical and Welded Joints**	**8 Hours**

Mechanical Joints: Riveted Joints -Types, rivet materials, Failures of Riveted joints, Efficiency, riveted joint for boiler or pressure vessels.

Welded Joints -Types, Strength of butt and fillet welds, welds subjected axial loads, Eccentric loading - welds subjected to bending moment.

Self-study component:	Study on Riveted brackets.

UNIT – IV	**Design of Gears and Springs**	**8 Hours**

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 non-circular cross sections. Tension and compression springs. (Simple problems).

Self-study component:	Problems on helical gears.

UNIT – V	**Design Of Shafts:**	**8 Hours**

Design Of Shafts: Torsion of shafts, design for strength & rigidity, with steady loading, ASME& BIS codes for design of transmission shafting, Design of shafts under different loads: Combined loads & Fluctuating loads.

Self-study component:	Problems on journal bearing

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Describe** the theories of failures and **Determine** the dimensions of mechanical components subjected to different types of static load.	Understanding	L3
CO2	**Compute** the dimensions of the machine elements subjected to fatigue and impact.	Analyzing	L3
CO3	**Distinguish** between different mechanical joints and design welded and riveted joints for various loads.	Remembering	L2
CO4	**Design** spur gear and different types of spring for different applications.	Applying	L3
CO5	**Design** the shaft for different load condition and comprehend the mechanism of lubrication and compare design of bearing for different applications.	Applying	L3

Text Book(s):

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 Book(s):

1. **Machine Design** -Robert .L, Norton -Pearson Education Asia, New Delhi, 2014.
2. **Design of Machine Elements** -V. B. Bahandri, -Tata McGraw Hill Publishing Co. Ltd., New –Delhi, 2000.
3. **Machine Design** -R.S.Khurmi, J. K.Gupta. – Eurasia publishing house private Ltd. New Delhi, 2005.

Web and Video link(s):

1. Introduction to Machine Design - Design of machine elements -1 by GURUDATT.H.M. - YouTube
2. Introduction to design for static strength & problems - #1, 2 - Mod_1 - DME_1 by GURUDATT.H.M - YouTube

E-Books/Resources:

1. DESIGN OF MACHINE ELEMENTS-UNIT 3 (methodist.edu.in)
2. Microsoft PowerPoint - MEL311-part-I (iitd.ac.in)

COMPOSITE MATERIALS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP5031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain the role of reinforcement and matrix in composite materials. Analyze the role of Prepegs in composites.
- List the application & uses of composites materials.
- Derive an expression for the Number of elastic constants, Hooke's law for two-dimensional angle lamina in composites.
- Explain the laminate codes in developing composite materials.
- Explain the different methods of composite material synthesis and testing methods for composites.

UNIT – I	**Introduction to Composite Materials**	**8 Hours**

Introduction to Composite Materials: Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.

Advanced Composites: Polymer Nanocomposites – Introduction, Nano clay, Carbon Nanofiber.

Self-study component:	Introduction to Carbon Nanotubes.

UNIT – II	**Applications of Composites, Metal Matrix Composites**	**8 Hours**

Applications: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment.

Metal Matrix Composites: Reinforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.

Self-study component:	Future Potential of Composites, Application of MMC in Locomotive Industries.

UNIT – III	**Macro Mechanics of a Lamina**	**8 Hours**

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, Numerical problems.

Self-study component:	Engineering Constants of an Angle Lamina.

UNIT – IV	**Manufacturing Methods of Composites**	**8 Hours**

Manufacturing Methods of Composites: Layup and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding. Introduction to Autoclave.

Self-study component:	Processing of thermoplastic composites.

UNIT – V	**Machining and Testing of Composites**	**8 Hours**

Machining and Testing of Composites: Cutting, Machining, joining and repair. NDT tests – Purpose, Types of defects. NDT method - Ultrasonic inspection, Radiography, Acoustic emission.

Self-study component:	Acoustic Ultrasonic Method

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Identify** and **Classify** the different types of fiber and matrix materials used in commercial composites and nanocomposites.	Remember	L1
CO2	**Outline** various applications of composites, its characterization and Role of MMC in engineering application.	Understanding	L3
CO3	**Derive** the expression for Hooke's Law, Maximum Stress and Strain Theory and number of elastic constants.	Analysing	L3
CO4	**Summarize** various methods of composite fabrication techniques and also understand the importance of ceramic matrix composites.	Applying	L2
CO5	**Describe** various Cutting and Testing methods of composite.	Understanding	L3

Text Book(s):

1. Mein Schwartz, "Composite Materials Handbook", McGraw Hill Book Company, 1984.
2. Autar K. Kaw, "Mechanics of composite materials", CRC Press New York, 8TH Edition 2005.

Reference Book(s):

1. Rober M. Joness, "Mechanics of Composite Materials", McGraw Hill Kogakusha Ltd.
2. Michael W, Hyer, "Stress analysis of fiber Reinforced Composite Materials", McGraw Hill International.
3. Composite Material Science and Engineering, Krishan K. Chawla Springer.
4. P. K. Mallik, "Fibre Reinforced Composites", Marcel Decker, Inc 1993, CRC Press, Third Ed.

Web and Video link(s):

1. https://www.youtube.com/watch?v=0kB0G6WKhKE&list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg
2. https://www.youtube.com/watch?v=ZZRg0kmNN7k
3. https://www.youtube.com/watch?v=RihoVfzEfWI

E-Books/Resources:

2. https://home.iitk.ac.in/~mohite/Composite_introduction.pdf
3. https://archive.nptel.ac.in/content/storage2/courses/105108124/pdf/Lecture_Notes/LNm1.pdf

INDUSTRIAL ROBOTICS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP5032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand Classifications, geometrical and configuration.
- Know the difference between accuracy and repeatability. Understand basic components and motion analysis of robots.
- Learn Euler formulations and trajectory planning processes of Robots.
- Understand the programming languages and Robot cell design and control.
- Understand different types of sensors**.**

UNIT – I	**Classification And Structure of Robotic Systems**	**8 Hours**

Classification And Structure of Robotic Systems: : Automation and robotics, brief history of robotics, Classifications, geometrical configuration, wrist and its motions and effectors and its types, links and joints. Robot drive system: Hydraulic, electric and pneumatic drive system resolution, accuracy and repeatability.

Self-study component:	Advantages and disadvantages of drive systems.

UNIT – II	**Robot Motion Analysis**	**8 Hours**

Robot Motion Analysis : Kinematics – Introduction, direct and inverse kinematics, rotation matrix, composite rotation matrix, rotation matrix about and arbitrary axis, Euler angles representations, homogeneous transformations, links, joints and their parameters.

Self-study component:	Stewart mechanism parallel-link robot.

UNIT – III	**Robot Arm Dynamics**	**8 Hours**

Robot Arm Dynamics: La Grange Euler formulations– joint velocities, kinetic energy potential energy and motion equations of robot manipulator, Newton, Euler formulations- Rotating coordinate systems.

Self-study component:	Applications of Robots in Automotive Industry.

UNIT – IV	**Trajectory Planning**	**8 Hours**

Trajectory Planning: Introduction, general considerations on trajectory planning, joint interpolated trajectories, 4 – 3 – 4 trajectory example. Planning of Cartesian path trajectories-Homogeneous transformation matrix.

Self-study component:	Material Handling Application in automotive industry.

UNIT – V	**Robot Programming, Robot Cell Design and Control**	**8 Hours**

Robot Programming: Methods of robot programming, Lead through programming methods, a robot program as a path in space, motion interpolation, commands-WAIT, SIGNAL, capabilities &limitations of Lead through methods.

Robot Cell Design and Control: Robot cell layouts, work cell control, error detection and recovery, graphical simulation of robotic work cell. Economic analysis for robots-method.

Self-study component:	Application of Sensors in Robots.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Explain** Classification and Structure of Industrial Robots System.	Remember	L2
CO2	**Describe** basic components of Robots and solve problems on motion analysis.	Understanding	L3
CO3	**Establish** Robot Arm Dynamics and able to solve problems on Euler formulations.	Understanding	L3
CO4	**Illustrate** trajectory planning processes of Robots and able to Identify Cartesian Path of Robots.	Analysing	L2
CO5	**Explain** different programming languages and Robot cell design and control.	Applying	L2

Text Book(s):

1. Groover, " Industrial Robotics", Tata McGraw-Hill Education, 2012
2. Yorem Korem, " Robotics" McGraw Hill Intl. Book Co., New Delhi, 1985
3. Fu, Gonzales and Lee, "Robotics", McGraw Hill. Edition, 1987

Reference Book(s):

1. Robotics Engineering An integrated approach - Richard D Klafter, Thomas A Chmielewski, Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.
2. Robert J. Schiling, "fundamentals of Robotics" McGraw Hill. Edition, 1987

Web and Video link(s):

1. https://www.youtube.com/watch?v=xrwz9IxpMJg&list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&index=2
2. https://www.youtube.com/watch?v=0qQKM2XYDDI&pp=ygUvQ2xhc3NpZmljYXRpb24gQW5kIFN0cnVjdHVyZSBvZiBSb2JvdGljIFN5c3RlbXM%3D
3. https://www.youtube.com/watch?v=zSvCAW-mowg&pp=ygUfdHJhamVjdG9yeSBwbGFubmluZyBpbiByb2JvdGljcw%3D%3D
4. https://archive.nptel.ac.in/courses/112/105/112105249/

E-Books/Resources:

- https://nptel.ac.in/courses/112101098

COMPUTER INTEGRATED MANUFACTURING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP5033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the meaning and types of Computer Integrated Manufacturing systems.
- Analyze the Transfer line without storage – upper bound and lower bound approach.
- Explain the functions of different parts feeding devices and elements of parts delivery system.
- Explain the concept of automated guided vehicle system used.
- Understand the concept of robots, robot configuration and different robot motion.

UNIT – I	**Computer Integrated Manufacturing Systems and High Volume Production System**	**8 Hours**

Computer Integrated Manufacturing Systems : Introduction, Automation definition, types of automation, CIM, processing in manufacturing, production concepts, Mathematical Models – Manufacturing lead time, production rate, components of operation time, capacity.

High Volume Production System: Introduction Automated flow line – symbols, objectives, work part transport – continuous, Intermittent synchronous, pallet fixtures.

Self-study component:	Automation for machining operation.

UNIT – II	**Analysis of Automated Flow Line & Line Balancing and Minimum Rational Work Element**	**8 Hours**

Analysis of Automated Flow Line & Line Balancing: General terminology and analysis, Analysis of Transfer Line without storage – upper bound approach, lower bound approach and problems.

Minimum Rational Work Element: Work station process time, Cycle time, precedence constraints, Precedence diagram.

Self-study component:	Problems on Computerized line balancing.

UNIT – III	**Automated Assembly Systems**	**8 Hours**

Automated Assembly Systems: Design for automated assembly systems, types of automated assembly system, Parts feeding devices – elements of parts delivery system – hopper, part feeder, Selectors, feedback, escapement and placement analysis of Multi station assembly.

Self-study component:	Machine analysis of single station assembly.

UNIT – IV	**Automated Guided Vehicle System and Computerized Manufacturing Planning System**	**8 Hours**

Automated Guided Vehicle System: Introduction, Vehicle guidance and routing, system management, Quantitative analysis of AGV's with numerical problems and application.

Computerized Manufacturing Planning System: Introduction, Computer aided Process Planning.

Self-study component:	Concepts of MRP and CRP.

UNIT – V	**CNC Machining Centers and Robotics**	**8 Hours**

CNC Machining Centers: Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.

Robotics: Introduction to robot configuration, Robot motion.

Self-study component:	Robot Sensors and Robot Applications.		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the mathematical models, the terms used in mathematical models, and different types of transfer mechanisms used.	Remember	L2
CO2	**Define** the upper bond and lower bond approach, Work station process time, Cycle time, precedence constraints, Precedence diagram, Balance delay methods of line balancing, **Explain** the effect of storage in industry.	Remember	L2
CO3	**Design** the assembly systems and parts feeding devices.	Understanding	L3
CO4	**Explain** the role and importance of AGV, CAPP and MRP.	Applying	L2
CO5	**Explain** the different elements of CNC, the steps involved in writing the CNC part programming and the concept of robots, robot configuration and different robot motion.	Analyzing	L2

Text Book(s):

1. Automation, Production system & Computer Integrated manufacturing,- M. P Groover Pearson India, 2007 2nd edition.
2. Principles of Computer Integrated Manufacturing, - S. Kant Vajpayee, Prentice Hall India.

Reference Book(s):

1. Computer Integrated Manufacturing, - J. A. Rehg & Henry. W. Kr CAD/ CAM by Zeid, Tata McGraw Hill.

Web and Video link(s):

1. Computer Integrated Manufacturing | Introduction to CIM Part-1| AKTU Digital Education - YouTube
2. noc20-me44-lec01 - YouTube

E-Books/Resources:

1. Microsoft Word - Chapter2C-CIM-introduction.doc (nchu.edu.tw)
2. CIM Notes.pdf (ecajmer.ac.in)

MODERN MACHINING METHODS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P18IP5034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Identifying the classification of unconventional machining processes.
- To understand the principle, mechanism of metal removal of various unconventional machining processes.
- To study the various process parameters and their effect on the component machined on various unconventional machining processes.
- To understand the applications of different processes.

UNIT – I	**Introduction and Abrasive Jet Machining**	**8 Hours**

Introduction: History, Classification, Comparison between conventional and non-conventional machining process selection, classification and process selection of the NTMM,

Abrasive Jet Machining (AJM): Introduction and working principle, Variables in AJM, Metal removal rate, Applications, advantages and disadvantages.

Self-study component:	Surface finishing of AJM and WJM

UNIT – II	**Water Jet Machining and Ultrasonic Machining**	**8 Hours**

Water Jet Machining: Introduction and working principle, nozzles, Applications, advantages and disadvantages.

Ultrasonic Machining (USM): Introduction and working principle, abrasive slurry, tool feed mechanism, Applications, advantages and disadvantages.

Self-study component:	surface finish of USM

UNIT – III	**Laser Beam Machining, Plasma Arc Machining and Electron Beam Machining**	**8 Hours**

Laser Beam Machining: Introduction and working principle, Advantages and limitations.

Plasma Arc Machining (PAM): Introduction and working principle, Applications, advantages and disadvantages.

Electron Beam Machining (EBM): Introduction & working principle, Applications, advantages and disadvantages.

Self-study component:	Difference between PAM & EBM

UNIT – IV	**Electrical Discharge Machining and Wire EDM**	**8 Hours**

Electrical Discharge Machining: Introduction and working principle, machine, mechanism of metal removal, Electrode feed control, Flushing and types, Metal removal rate, Accuracy and surface finish, Applications, advantages and disadvantages.

Wire EDM: Introduction and working principle Applications, advantages and disadvantages.

Self-study component:	Selection of Electrode Material for EDM

UNIT – V	**Electrochemical Machining and Chemical Machining**	**8 Hours**

Electrochemical Machining (ECM): Introduction and working principle, Electrolyte: function, properties and selection. Chemistry of the process, Working principle: Electro chemical Grinding, Electro chemical Deburring

and Electro chemical Honing process.

Chemical Machining (CHM): Introduction and working principle, application, Advantages and Disadvantages.

Self-study component:	Applications of Electrochemical Grinding, Deburring and Honing.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the principles and applications of AJM & WJM	Remember	L2
CO2	**Discuss** the basic principles involved in ultrasonic machining.	Understanding	L3
CO3	**Identify** the issues involved in thermal metal removal process.	Understanding	L1
CO4	**Describe** various parameters which govern the different techniques of analysing EDM process and characteristics.	Applying	L3
CO5	**Illustrate** the chemistry and metal removal process in electro-chemical and chemical machining techniques.	Applying	L3

Text Book(s):

1. Modern machining process – Pandey and Shan, TATA McGraw Hill 2016. ISBN-0-07-096553-6
2. Production Technology- P C Sharma, S Chand and Company Ltd, ISBN-81-219-1114-1.
3. Advance Machining Processes by Vijay K. Jain – Allied Publishers Private Ltd, 2013

Reference Book(s):

1. Production Technology - HMT TATA McGraw Hill 2016.

Web and Video link(s):

1. https://www.youtube.com/watch?v=tTnXn498F90&list=PLWv6RLxuaVQwMg6kFEoeeMEGTWNnr7Jmr
2. https://www.youtube.com/watch?v=VrlCH1FZSJM&list=PLWv6RLxuaVQwMg6kFEoeeMEGTWNnr7Jmr&index=2
3. https://www.youtube.com/watch?v=dmHv42wda9k&list=PLWv6RLxuaVQwMg6kFEoeeMEGTWNnr7Jmr&index=7
4. https://www.youtube.com/watch?v=PaYInS9axxw&list=PLzCSUZGIUJkaSyCzPiQMWynGyxmC8hrpl

E-Books/Resources:

4. https://drive.google.com/file/d/104R_doeqJPXf0r8fT3tGB02RItyuHLSQ/view
5. https://drive.google.com/file/d/1ER2fjYxyixRWweC6G9Q3mO4aRtu7JJjr/view
6. https://drive.google.com/file/d/1Ncs50GneGGLqxQrNS-_UJC0luxWXRZWp/view
7. https://www.me.iitb.ac.in/~ramesh/courses/ME338/non_trad.pdf

WORK STUDY AND ERGONOMICS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IP504**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Summarizing the basics of the Productivity and Work study and various methods of Wages and Incentives.
- Pointing out the drawbacks of present method and design the best method.
- Comparing the different methods of calculating standard time of a work.
- Explaining the fundamentals of Ergonomics.
- Developing the Man/machine system on foundation of Ergonomics

UNIT – I	**Productivity & Work Study**	**8 Hours**

Productivity & Work Study: Basic needs, Quality of life and Productivity, Definition of productivity, Productivity in the individual enterprise, The task of Management, Definition of Work study, How the total time of a job is made up, Interrelationship of the various methods used to reduce ineffective time, wage rates, wage incentives and its types, Straight and differential piece rate system, Emerson efficiency plan, Halsey plans, Rowan plan, group incentives. Work study as a valuable tool, Techniques & Basic procedure of work study, direct means of raising productivity.

Self-study component:	Human Factor in the application of the work study.
Practical Topics:	• Rating exercises • Application of principle of motion economy

UNIT – II	**Method Study**	**8 Hours**

Method Study: Definition, Procedure, Selection of work, Process chart symbols, Outline process and flow process charts, Flow and string diagrams, multiple activity chart, travel chart, principles of motion economy, classification of movements, two-handed process chart Micro motion study. Other recording techniques.

Self-study component:	Development of improved methods, define, install and maintain.
Practical Topics:	Recording Techniques: preparing the following charts and diagrams • Outline process chart • Flow process chart • Flow diagram • Two handed process charts

UNIT – III	**Work Measurement**	**8 Hours**

Work Measurement: Definition, purpose, uses, Procedure, techniques, Work sampling: Need, determination of sample size, procedure for selecting random observations, conduction of study with the simple problems, Time study: Definition, basic steps in time study. Recording the information, breaking the jobs into elements, types of elements, determination of sample size, and timing elements by stop-watch, rating & standard Rating.

Self-study component:	Time study allowances and standard time determination. Predetermined time standards, Time study equipment.
Practical Topics:	Measurement of effect of work on human body (Ergometer, Treadmill)

UNIT – IV	**Introduction To Ergonomics**	**8 Hours**

Introduction To Ergonomics: Introduction, Consequences of not using Ergonomics, areas of study covered under ergonomics, system approach to ergonomics models, Man-Machine system, and Characteristics of Man-

Machine system, work capabilities of industrial worker, Functions performed by Man and Mechanism involved, general principles for carrying out the physical activities.		
Self-study component:	Development of stress in human body and their consequences, Suggestions for prevention.	
Practical Topics:	Determining the standard time for simple operation using stop watches and PMTS (using video camera)	
UNIT – V	**Design Of Man-Machine System**	**8 Hours**
Design Of Man-Machine System: Concept of fatigue in industrial work, Displays, Quantitative qualitative representation and alphanumeric displays. Controls and their design criteria, control types, relation between controls and displays. Design of work places, influence of climate on the efficiency of human performance, Influence of noise, vibrations and lighting systems on human performance.		
Self-study component:	Layout of panels and machines.	
Practical Topics:	• Effect of Noise on human efficiency. • Introduction to ECG, EMG & BP Measurements.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Summarizing** the basics of the Productivity and Work study and various methods ofWages and Incentives.	Remember	L1
CO2	**Pointing** out the drawbacks of present method and design the best method.	Understanding	L2
CO3	**Comparing** the different methods of calculating standard time of a work.	Understanding	L2
CO4	**Explaining** the fundamentals of Ergonomics.	Applying	L3
CO5	**Developing** the Man/machine system on foundation of Ergonomics	Applying	L3

Text Book(s):

1. Introduction to work study- ILO, IV Revised Edition, 2003.
2. Text book of Work Study and Ergonomics– S Dalela and Saurabh, Standard Publishers Distributors, 5th edition,1999

Reference Book(s):

1. Motion and Time study- Ralph M Barnes, John Wiley, 8th Edition, 1985.
2. Human Factors in Engineering Design-6th Edition, M S Sanders and E J McCormic, Mc Graw Hill.

Web and Video link(s):

1. https://www.youtube.com/watch?v=-3yQ-XQnkYM
2. https://www.youtube.com/watch?v=KNFZXNWYVno

E-Books/Resources:

- http://assets.cambridge.org/97811075/03366/excerpt/9781107503366_excerpt.pdf
- https://nscpolteksby.ac.id/ebook/files/Ebook/Hospitality/Production%20and%20Operations%20Management%20(2008)/8.%20Chapter%207%20-%20WORK%20STUDY%20%28TIME%20AND%20MOTION%20STUDY%29.pdf
- https://apps.who.int/iris/bitstream/handle/10665/37137/Introduction-to-Ergonomics-1972-en.pdf?sequence=1

PRINCIPLES OF MARKETING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IPO5051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Illustrate the Basics of Marketing and its Management [L2]
- Understanding the customer by through the Marketing information systems [L2]
- Analyzing and comparing the consumer and Business Markets [L4]
- Explaining the Product, Service and related strategies [L2]
- Composing the proper Pricing and Distribution strategies [L6]
- Designing the suitable Promotion system and maximizing the use of online marketing system [L6]

UNIT – I	**Introduction – Principles of Marketing**	**7 Hours**

Introduction: Definition of Marketing, The marketing process, understanding the market place and customer needs, Designing a customer- driven marketing strategy, Companywide Strategic planning, Marketing strategy and the Marketing mix.

Self-study component:	Company's Micro and Macro Environment.

UNIT – II	**MIS, Consumer Markets, Buying Behaviour and Markets and Business Behavior**	**9 Hours**

Managing Marketing Information Systems to Gain Customer Insights: Marketing Information and customer insights, Assessing Marketing information needs, developing marketing information.
Consumer and Business Markets and Buying Behaviour: Model of consumer behavior, Characteristics affecting Consumer behavior, Types of buying decision behavior, buying decision Process (Brief). A model of business buyer behavior, participants in the Business buying process, major influences on business buyers.

Self-study component:	Market Segmentation and Market targeting.

UNIT – III	**Product & Services and Product Related Strategies**	**8 Hours**

Product & Services: The concept of a product, Levels of product, Individual product and service decisions: product line decisions, product mix decisions, services marketing, New –product; idea, new – product development process.

Product Related Strategies: Branding strategy: Building strong brands, Packaging and Labeling.

Self-study component:	Product support services.

UNIT – IV	**Pricing and Distribution**	**8 Hours**

Pricing: Definition, Factors to consider when setting prices**,** New product pricing strategies product mix pricing strategies, price adjustment strategies, Initiating and Responding to price changes.

Distribution: The nature and importance of Marketing channels, channel behavior and organization, channel design decisions, channel management decisions.

Self-study component:	Marketing logistics and supply chain management.

UNIT – V	**Promotion, Personal selling and E Marketing**	**8 Hours**

Promotion: Advertising: Definition, objectives, Budget, Developing strategy, Public relations,
Personal selling: Definition, Nature, Role of the sales force, the personal selling process, Sales Promotion: Definition, objectives and Tools.

Digital or E-Marketing: Online Marketing Communication and Promotional Opportunities, 7C's and Marketing 4.0.

Self-study component:	Managing the sales force.		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the Marketing and its Management and marketing information systems.	Understanding	L1
CO2	**Describing** and **Distinguishing** the consumer and Business Markets and their behaviors.	Remember	L3
CO3	**Explaining** the Product, Service and related strategies.	Remember	L2
CO4	**Proposing** Pricing and Distribution strategies.	Applying	L3
CO5	**Composing** the suitable Promotion system and using the online marketing system.	Applying	L3

Text Book(s):

1. inciples of Marketing- Philip Kotler, Gary Armstrong, PHI,. 13th edn, 2013
2. Marketing Management S.A Sherlaker, 2011

Reference Book(s):

1. Fundamentals of Marketing- William J Stanton, McGraw Hill, 1994.
2. Marketing Management Text & Cases- Rajagopal, Vikas Publishing House, 2008

Web and Video link(s):

1. Principles of Marketing – Chapter 1: What Is Marketing | Philip Kotler - YouTubeLasers:
2. E Marketing : meaning, definition, advantages, disadvantages, types, marketing management, bba mba - YouTube

E-Books/Resources:

1. Principles of Marketing (openstax.org)
2. Principles of Marketing (jmpcollege.org)
3. Principle_Marketing.pdf (ddceutkal.ac.in)

Control Engineering And Machine Tool Drive [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IPO5052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The objective of the course is to provide the students an opportunity to gain the knowledge in the field of Control Engineering and Machine tool Drive.
- To learn the response analysis of control systems using first order differential equations and to solve simple problems.
- Demonstrate the block diagrams and signal flow graphs and to solve problems.
- To learn the basic feature and Kinematic requirements of Machine tools and different drives.
- The students should learn the knowledge to analyze and design the gear box.

UNIT – I	**Basic of Control System and Modelling of Control System**	**8 Hours**

Basic of Control System: Concept of automatic controls, classification of control systems, open and closed loop systems, concepts of feedback, Requirement of an ideal control system. Any two Real time application of open and closed loop control system, Feedback and feed forward system, Comparison of close loop and open loop system.

Modelling of Control System: Analysis of mechanical systems (Translation motion and Rotational motion) Equivalent mechanical system (node system), Electrical systems, Analogous systems (loop analysis and node analysis). Problems

Self-study component:	Deterministic and stochastic control systems.

UNIT – II	**Electro Mechanical Systems and Time Response Analysis of Control Systems**	**8 Hours**

Electro Mechanical Systems: DC Servomotors (field and armature controlled).

Time Response Analysis of Control Systems: Definition and classification of time response, Standard test inputs, Derivation of steady state error, Effect of input (Type of Magnitude) on steady state error (Static Error Coefficient Method), Effect of Change in G(s) H(s) on Steady State Error: step, ramp, parabolic, problems.

Self-study component:	Disadvantages of static error coefficient method.

UNIT – III	**Block Diagrams and Signal Flow Graphs**	**8 Hours**

Block Diagrams: Derivation of Transfer function of simple closed loop system, Rules for Block Diagram Reduction, Critical Rules, Procedure to solve block diagram in canonical form, Problems on block diagram.

Signal Flow Graphs: Properties of signal flow graphs, Terminology, Methods to obtain Signal Flow Graph, Mason's gain formula, Problems on signal flow graph.

Self-study component:	Advantages of block diagram.

UNIT – IV	**Basic Feature and Kinematic Requirements of Machine Tools**	**8 Hours**

Basic Feature and Kinematic Requirements of Machine Tools: Machine tool, characteristics, Objectives, production capacity, stiffness and rigidity, classification, control system, cutting motion, Essential requirement, Design of basic features of a machine tool, common type of slide ways, Method of production of surfaces, General requirements of machine tool design

Self-study component:	Materials for bed and guides.

UNIT – V	Kinematic Drives Of Machine Tools	8 Hours

Kinematic Drives Of Machine Tools: Machine tool drive, classification, individual and group drive, electric motors for drive, stepped and stepless drive, Layout of speeds in Arithmetic, Geometric and Logarithmic progression, Mechanical stepless drives, PIV drive, Hydraulic drives for shaper and milling machine.

Machine tool spindle speeds, Ray diagram, Speed diagram, Gear box design, (Problems on Gear box design).

Self-study component:	Clutch system in machine tool.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	The students should learn and **Understand** necessity of basics of Control Engineering and Machine tool Drive.	Understanding	L1
CO2	Students will be able to **Identify** and learn response analysis of control system and solve engineering problems.	Remember	L1
CO3	The students will be able to **Solve** the block diagrams and signal flow graphs.	Applying	L3
CO4	Students should be able to **Demonstrate** the general features of machine tools.	Analysing	L3
CO5	Students should be able to **Solve** the given gear box.	Applying	L3

Text Book(s):

1. Modern Control Engineering –K Ogatta, Prentice Hall (India) Pearson Education 2003.
2. Automatic Control Systems-Francis. H Raven 5thEdition.McGraw Hill 1995.
3. Principles of Machine tools-Sen and Bhattacharyya
4. Machine Tool Engineering – G.R. Nagpal, Khanna Publishers, 1999.

Reference Book(s):

1. Feedback control system-Schaum'S series.2001
2. Control systems-I J Nagarath& M Gopal, New age International Publishers 2002
3. Control systems –M Gopal.TATAMcGraw Hill New Delhi 2ndEdistion 2002.
4. Control Engineering –U A BakshiV.U. Bakshi. Technical Publications Pune.New edition.
5. Modern Control Systems- Richard C Drof and Robert.H.Bishop Addison- Wesley,8th Edition,1998.
6. Automatic Control System –B.CKuo- Prentice Hall (India),1995.
7. System Dynamics & Control-EroniniumezTho Learning 2002.

WORLD CLASS MANUFACTURING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21IPO5053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain the different frameworks ,Manufacturing Excellence and Competitiveness of WCM
- Identify principles, practices and tools of WCM
- Explain the Bench marking process concepts
- Define Reengineering and Explain Rethinking business process
- Explain the core of six sigma and six sigma different methods
- Discuss Activity Based Management and Theory of Constraints.

UNIT – I	**Introduction to World Class Manufacturing**	**8 Hours**

Introduction to 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.

World Class Manufacturing: The philosophy of world-class Manufacturing-The First Principles of World-Class Manufacturing, The practices of World-Class Manufacturing-The customers Interface, The Supplier Interface.

Self-study component:	Maskell's Model of World-Class Manufacturing.

UNIT – II	**Principles and Practices of WCM and Systems and Tools for WCM**	**8 Hours**

Principles and Practices of WCM: Data collection plan, research-internal public domain sources, outside expert's etc. original research

Systems and Tools for WCM: Information management tools: Product and Process design tool, bar code systems. Material processing and handling tools: flexible manufacturing systems, rapid prototyping.

Self-study component:	Value Stream Mapping.

UNIT – III	**Benchmarking**	**8 Hours**

Benchmarking: Definition, Need, phases and managing benchmarking process, future scope and benchmarking process. What to benchmark: business processes – linking to goals etc documentation, improving business processes. Whom to benchmarks: Developing candidate list, systematic search.

Self-study component:	Objectives of Bench Marking.

UNIT – IV	**Reengineering and Quality Systems**	**8 Hours**

Reengineering: Importance of 3Cs-customers takes charges, Definition of Business Process Reengineering – fundamentals rethinking.

Quality Systems: ISO 9000-2000, IS 14000, Frame Work for Business Excellence – Malcolm Baldridge Award, Deming's Award.

Self-study component:	Case studies on Re-Engineering in Industries.

UNIT – V	**Six Sigma and Theory of Constraints**	**8 Hours**

Six Sigma: The Basics, The core of Six Sigma (DMAIC), design for Six Sigma, DFSS and the customer, Core of DFSS-IDOV method DFSS Metrics.

Theory of Constraints (TOC): Theory of Inventive Problem Solving.

Self-study component:	Implementing DFSS.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Recognize** different frame work models followed by quality Guru's and the Principles of WCM and Practices used in Factory.	Remember	L2
CO2	**Summarize** the Importance of Data Collection Methods used and Tools used in Factory while implementing WCM.	Understanding	L1
CO3	**Analyse** the different methods of Bench Marking Process, and significance of Value Stream Mapping.	Analysing	L3
CO4	**Recognize** fundamental concepts of Reengineering and Quality system and Importance of ISO in Manufacturing Industries.	Remember	L2
CO5	**Employing** Six Sigma concepts in industries and Impact of Activity Based Management and Theory of Constraints.	Applying	L3

Text Book(s):

1. Hammer, Michael and James Champy. Reengineering the corporation-A Manifesto for Business revolution, Nicholas Brealey Publishing ,London.- 1995
2. Finding and Implementing Best Practices- Business Process Benchmarking, Champ ,Robert C. Vision Books , New Delhi – 2008
3. World Class Manufacturing- A Strategic Perspective-Sahay B S, Saxena K B C, Ashish Kumar, MacMillan – India Ltd, ISBN 0333- 93-4741.
4. Six sigma for Managers- TMH 2002,Greg Brue,, ISBN- 0-07- 048639-5

Reference Book(s):

1. Design for Six Sigma -Grege, TMH 2003,ISBN 0-07-058120
2. Clyde M. Creveling, Design for Six Sigma Technology and Product Development –Pearson Education – 2008.
3. Total Quality Management -Dale H. Besterfield, carol Besterfield- Minchna, glen H Besterfield and Mary Besterfield –Scare, ,3rd edition Pearson education, ISBN 81-297-0260-6

Web and Video link(s):

1. https://www.youtube.com/watch?v=4tjhiKTqS-Y
2. https://www.youtube.com/watch?v=sO0so-zjZMc
3. https://www.youtube.com/watch?v=4EDYfSl-fmc

E-Books/Resources:

8. https://www.researchgate.net/publication/346089416_World_Class_Manufacturing

PLANT LAYOUT AND DESIGN [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21IPO5054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand and apply the concept of different plant layouts and plant design [L3]
- Understand the ability to identify the objective to recognize about plant location problems.[L3]
- The student should be able to understand the concept of objectives of plant layout [L2]
- Apply the basic concepts of material and processing [L3]
- Understand the general concept of material handling equipment and storage in plant layout [L2]

UNIT – I	**Introduction To Plant Design**	**8 Hours**

Introduction To Plant Design: Types of manufacturing processes, Plant design: Graphical portrayal of some of the phases of plant design, Acquisition of capital, Product design, Sales planning for requirements, Selection of the production of process, , Plant size, Product price range, Plant location, plant layout, building-type selection, Diversification, Organization development. Factors influencing plant location, Theories of plant location and location economics.

Self-study component:	Make or buy and simple problems.

UNIT – II	**Sales Planning For Plant Design and Plant Location**	**8 Hours**

Sales Planning For Plant Design: Introduction, Importance of sales planning, Determination of volume of output, Market method, Market research.

Plant Location: Introduction, Plant location problem, Levels of location problems, Location factors, Location theory and models.

Self-study component:	Building design and construction.

UNIT – III	**The Plant Layout Problem**	**8 Hours**

The Plant Layout Problem: Introduction, Plant layout problem, Classes of plant layout problems, Objectives of good plant layout, Classical types of layouts, Advantages of good plant layout. Operation process chart, Calculation of equipment requirements, Product flow, Space requirements (simple problems).

Self-study component:	Labour utilization, worker convenience and job satisfaction.

UNIT – IV	**Evaluation of Layouts and Data Collection**	**8 Hours**

Evaluation of Layouts: Introduction, Systematic evaluation: sequence demand – straight line method, sequence demand- non directional, simple problems.

Data Collection: Introduction, material and processes, equipment required for product layout, simple problems.

Self-study component:	Space based on present layout, Production-center method.

UNIT – V	**Materials Handling Equipment and Line Balancing**	**8 Hours**

Materials Handling Equipment: Introduction, conveyers; portable conveyers, power conveyers, overhead conveyers, cranes; mobile crane, overhead traveling crane, elevators and hoists. Industrial vehicles; fork trucks, high lift platform truck, powered hand trucks, industrial tractor, Storage: Methods of storage

Line Balancing: requirement for line balancing, Assembly line balancing and problems on Dr. J R Jackson method.

Self-study component:	Working conditions, maintenance and supply of storage.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the concept of different plant layouts and plant design	Remember	L2
CO2	Ability to **Identify** the objective to recognize about plant	Understanding	L1
CO3	The student should be able to **Classify** the plant layout and problems	Understanding	L1
CO4	**Apply** the basic concepts of material and processing	Applying	L2
CO5	**Evaluate** the general concept of material handling equipment and storage in plant layout	Analysing	L3

Text Book(s):

1. James M Apple, "Plant Layout and Material handling" 3rd Edition, John, Wiley and Sons, ISBN 0-471-07171-4
2. Francies, R.L. and White, J.A. "Facility layout and Location", Mc Graw Hill 2nd Edition, 2009
3. James M Moore, "Plant Layout Design" - McMillan Company. Published by Prentice Hall College Div, New York (1962)

Reference Book(s):

1. Muther Richard, "Practical layout", Mc Graw Hill-1955.
2. Sunderesh Heragu, "Facilities Design" PWS Publishing Company, ISBN-0-534-95183.
3. Chandrashekar H , B Raghavendra Reddy, Facility planning and layout design, First Edition 2007, Technical Publication , Pune.

ADVANCED GEOMETRIC MODELLING LAB

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21IPL506**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**32**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Produce computer-aided mechanical drawings of components and assemblies of machine parts and other mechanical Equipment's.
- Interpreting and applying drafting standards.
- Using software for CAD such as Solid Works, etc.,
- Drawing sectional views and Assembly drawings.
- Drawing Surface Modelling for Simple Components.

	Introduction To Plant Design	**32 Hours**

Solid Works Basics: Introducing Solid Works, Navigating SolidWorks Interface.

Working with sketches: Opening a sketch, Identifying sketch entities, Exploring sketch settings, Sketch blocks, working with Reference Geometry, Creating planes, Sketch Relations.

Creating simple parts: Symmetry, Relative size or direct dimensions, Offset, Hole Wizard, Cutting a slot, Fillets and Chamfers, Editing Sketch Relations and Copying and Moving Sketch Entities.

Pattern and Mirroring: Linear and Circular Pattern, Mirror Entities, Dynamic Mirror, Symmetry sketch relation and Mirroring in 3D sketches.

Solid Modelling: Primitive creation, Simple solid shapes - Boolean operations and Surface operations: Chamfering, rounding, filleting. Drafting and shelling.

Dimension and Tolerance: Dimensions on Drawings, reference dimensions, dimension options, adding tolerances and Dimensioning Styles.

Assembly: Identifying the Elements of an Assembly, Assembly layout sketch, Assembly reference geometry, History-based and non-history based portions of the assembly tree, Parts and Subassemblies, Folders, Mates, Assembly features, Component patterns and mirror components, Creating subassemblies from existing parts and Grouping subassemblies by relative motion.

Surface Modelling: Basic Surfacing, Revolved Surface, Swept Surface, Filleting Surfaces etc.

Minimum of 10 Exercises in Modelling of Mechanical components and 4 assemblies using parametric feature based projects using CAD Software.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Recognize** the drawing concepts	Remember	L1
CO2	**Use** CAD software such as Solid Works, Solid Edge etc.	Understanding	L1
CO3	**Develop** machine parts and parts of equipment's in 3D.	Applying	L3
CO4	**Construct** sectional views and Assembly drawings.	Applying	L3
CO5	**Develop** surface models.	Applying	L3

Text Book(s):

1. Matt Lombard, **"Solid Works bible"**, Wiley Publishing, Inc, USA.
2. Solid Works Manual by Dassault System Inc.

Internship - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21INT507**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:0**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

Internship-II: SEE component will be the only seminar/Presentation and question answer session

Social Connect and Responsibility

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21UHV509**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**25+5**	**SEE Marks:**	**--**

Course Outcomes: This course will enable the students to:

- **Identify** the needs of the community and involve them in problem solving.
- **Demonstrate** the knowledge about the culture and societal realities.
- **Develop** sense of responsibilities and bond with the local community.
- **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.
- **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

PART-I

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.

PART-II

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

PART-III

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

PART-IV

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

PART-V

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the needs of the community and involve them in problem **solving.**	**Knowledge / Apply**	**L1 & L3**
CO2	**Demonstrate** the knowledge about the culture and societal realities.	**Understand**	**L2**
CO3	**Develop** sense of responsibilities and bond with the local community	**Apply**	**L4**
CO4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	**Apply**	**L4**
CO5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	**Create**	**L6**

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Identify** the needs of the community and involve them in problem **solving.**	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	**Demonstrate** the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	**Develop** sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period.

The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5th semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.

Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	**Group size**	Location	**Activity execution**	**Reporting**	**Evaluation Of the Topic**
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Employability Enhancement Skills (EES) - V
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21HSMC508**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Apply programming constructs of C language to solve the real-world problem.
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems.
- Design and Develop solutions to problems using functions.

UNIT – I	**10 Hours**

Problem solving through C -

Flow Control: If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs.
Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs
Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.

Self-Study: Variables and constants

UNIT – II	**10 Hours**

Problem solving through C -

Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples.
Strings: String Functions, String Examples, Programs.
Self-Study: Evaluation of Expression.

UNIT – III	**08 Hours**

Problem solving through C -

Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs.
Programming Files: Files Input/output

Self-Study: Error handling during I/O operations.

Course Outcomes: On completion of this course, students are able to:

CO – 1:	Apply suitable programming constructs of C language to solve the given problem.
CO – 2:	Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting.
CO – 3:	Design and Develop solutions to problems using functions.

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Computer fundamentals and programming in c, "Reema Thareja", Oxford University, Second edition, 2017.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - V**]**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	2	-	-	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-

QUALITY ASSURANCE AND RELIABILITY [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21IP601**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The aim of the course is to provide the students an opportunity to gain the knowledge in the field of Quality,
- Apply the fundamental concepts of Quality principal and to solve the Quality problems.
- To demonstrate the advantages, applications, limitations of the several of Quality functions and charts.
- To gain the knowledge for various control charts for attributes.
- The students gain the knowledge of different sampling inspection and to understand the different methods of Failure models of components, MTBF, Failure rate, common failure rate curve, types of failure.

UNIT – I	**Introduction and Quality Assurance**	**8 Hours**

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.

Quality Assurance: Definition and concept of quality assurance, Quality assurance function, departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing audit activities, audit reporting.

Self-study component:	Brief discussion on sporadic and chronic quality problems. Introduction to Quality function deployment.

UNIT – II	**SPC and Control Charts for Variables**	**8 Hours**

Statistical Process Control: Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, Process capability – Basic definition, standardized formula.

Control Charts For Variables: Controls charts for X bar and Range R, statistical basis of the charts, development and use of X bar and R charts. Control charts for X bar and standard deviation (S), development and use of X bar and S chart.

Self-study component:	Relation to product tolerance and six sigma concept of process capability.

UNIT – III	*Control Charts for Attributes*	**8 Hours**

Control Charts For Attributes: Controls chart for fraction non- conforming (defectives) development and operation of control chart, Control chart for non-conformities (defects) – development and operation of control chart for Department of Industrial and Production Engineering constant sample size and variable sample size. Choice between variables and attributes control charts.

Self-study component:	Guidelines for implementing control charts.

UNIT – IV	**Sampling Inspection**	**8 Hours**

Sampling Inspection: Concept of accepting sampling, economics of inspection, Acceptance plans – single and double sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans.

Self-study component:	Normal distribution concept	
UNIT – V	**Reliability and Life Testing**	**8 Hours**

Reliability and Life Testing: Definition of reliability, MTBF, MTTF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, parallel and series-parallel device configurations, Redundancy and improvement factors evaluations.

Self-study component:	Failure models of components.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	The aim of the course is to provide the students an opportunity to gain the knowledge in the field of Quality,	Remember	L1
CO2	Apply the fundamental concepts of Quality principal and to solve the Quality problems.	Understanding	L2
CO3	To demonstrate the advantages, applications, limitations of the several of Quality functions and charts.	Understanding	L2
CO4	To gain the knowledge for various control charts for attributes.	Applying	L3
CO5	The students gain the knowledge of different sampling inspection and to understand the different methods of Failure models of components, MTBF, Failure rate, common failure rate curve, types of failure.	Applying	L3

Text Book(s):

1. Introduction to statistical Quality Control- D C Montgomery 3rd Edition, John Wiley and Sons.
2. Quality Planning & Analysis- J M Juran, Frank M Gryna; 3rd edition, Tata McGraw Hill.

Reference Book(s):

1. Statistical Quality Control- Grant and Leavenworth, 6th Edition McGraw Hill,
2. The QS9000 Documentation Toolkit- Janet L Novak and Kathleen C Bosheers, 2nd Edition, Prenctice Hall PTR.
3. ISO 9000 a Manual for Total Quality Management-, Suresh Dalela and Saurabh, 1st Edition, S Chand and Co.
4. Total Quality Management-I KesavanR.K. International, New Delhi – 2007.
5. Statistical Quality control – M. Mahajan, Dhanpat Rai & Co. (p) LTD.

Web and Video link(s):

1. https://www.youtube.com/watch?v=0hzqHwu1i_I
2. https://www.youtube.com/watch?v=lOEqli-YV2I
3. https://www.youtube.com/watch?v=SpvxMvj95ko&pp=ygUec2FtcGxpbmcgaW4gcXVhbGl0eSBtYW5hZ2VtZW50

E-Books/Resources:

1. https://www.researchgate.net/publication/237287165_Chapter_4_QUALITY_ASSURANCE
2. https://www.ghsp.com/files/Statistical_Process_Control_%28SPC%29_Pt._I_.pdf
3. https://books.google.com/books?id=lUBoORXcHjMC&printsec=copyright

0.

OPERATIONS MANAGEMENT

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21IP6021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the Historical development of Operations Management concept, types of Manufacturing systems, concept of Productivity.
- Understand the importance of decision making in an organization and different methodologies and models.
- Identify the Objectives, variables and different methods used for Forecasting.
- Understand the importance of MRP and CRP techniques.
- Identify and analyze the different Scheduling and controlling techniques and Lean System concept.

UNIT – I	**Introduction and Decision Making**	**8 Hours**

Operations Management Concepts: Introduction, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, the environment of operations.

Operations Decision Making: Introduction, Management as a science, Framework for decision making, Decision methodology, Decision support systems, Economic models, Statistical models.

Self-study component:	Historical development of OM, Characteristics of decisions.

UNIT – II	**System Design and Forecasting**	**8 Hours**

System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.

Forecasting Demand: Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of forecasts.

Self-study component:	Forecasting objectives and uses, Objectives of aggregate planning.

UNIT – III	**Aggregate Planning and Master Scheduling**	**8 Hours**

Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Aggregate planning methods. Master scheduling objectives, Master scheduling methods.

Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, and Capacity management.

Self-study component:	CRP activities.

UNIT – IV	**Scheduling and Controlling Production Activities**	**8 Hours**

Scheduling and Controlling Production Activities: Introduction, scheduling strategy and guide lines, Scheduling methodology, priority control and capacity control.

Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule and minimizing the number of tardy jobs.

Self-study component:	PAC, Objectives and Data requirements.

UNIT – V	**Flow Shop and Job Shop Scheduling**	**8 Hours**

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3machines, CDS heuristic.
Job-Shop Scheduling: Types of schedules, Heuristic procedure, and scheduling 2 jobs on 'm' machines.

Self-study component:	Application of Johnson's Rule.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Define** importance of management in the organization and the different types of in an organization.	Remember	L1
CO2	**Distinguish** between the Manufacturing and Service oriented organizations and solve the problems on decision making.	Understanding	L2
CO3	**Define** the different types of Forecasting Techniques and solve the different problems on Forecasting Technique.	Remember	L1
CO4	**Understand** the concept of Break-even point and solve the different types of problems.	Applying	L3
CO5	**Understand** the concept of Scheduling and solve the different types of problems on Scheduling.	Applying	L3

Text Book(s):

1. Operations Management- Monks, J.G., McGraw-Hill International Editions, 1987.
2. Production and Operations Management- Pannerselvam. R, 2nd edition PHI.
3. Productions & operations management - Adam & Ebert.5th edition PHI.

Reference Book(s):

1. Modern Production/Operations Management- Buffa, Wiely Eastern Ltd., 4th edition.
2. Production and Operations Management- Chary, S.N, Tata- McGraw Hill., 3rd edition.
3. Operations management - James Dilworth. PHI, 3rd edition.
4. Operations Management – Lee J Karjewski and Larry P Ritzman, strategy and Analysis, 6th Edn, Pearson Education Asia.

Web and Video link(s):

1. https://www.youtube.com/watch?v=_VJkKZFuRvE&list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i
2. https://www.youtube.com/watch?v=7Hphv79OZJY&list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i&index=13
3. https://www.youtube.com/watch?v=VjSgga4E6VY&list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i&index=45
4. https://www.youtube.com/watch?v=1kU8HG5Y9Kc&list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i&index=58

E-Books/Resources:

1. https://www.edureka.co/blog/operations-management-definition
2. https://pdfkeys.com/download/1304945-Operations-Management-Krajewski.pdf

PRODUCT DESIGN AND MANUFACTURING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Identify and explain the basic requirements to develop a new product, Phases involved in design and Role of Tolerance and Process capability in Product Design.
- Explain the Role of Aesthetic and Role of 3'S in developing a new Product.
- Define and Explain the Strength, Stiffness and Rigidity considerations in product design.
- Explain the role of Design, Process engineers and the Problems faced by industrial Designer.
- Explain the process involved in Designing Plastics, Rubber & Ceramics parts.
- Identify the Economic factors influencing Design and how to add Value to product.

UNIT – I	**Introduction to Product Design**	**8 Hours**

Introduction to Product Design: Asimov's Model: definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production – Consumption Cycle, The Morphology of Design (The seven phases), Primary Design Phases and flowcharting, Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly.

Self-study component:	The challenges of product development.

UNIT – II	**Product Design Practice And Industry**	**8 Hours**

Product Design Practice And Industry: Induction, Product Strategies, Time to Market, Analysis of the Product, The Three S's, Standardization, Renard Series (Preferred Numbers), Simplification, The Designer and His Role, The Industrial design Organization, Basic Design Considerations, Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, Role of Aesthetics in Product Design, Functional Design Practice.

Self-study component:	Flexible Manufacturing System.

UNIT – III	**Design For Production –Metal Parts, Plastics And Rubber Parts**	**8 Hours**

Design For Production –Metal Parts, Plastics And Rubber Parts: Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms. Approach to Design with Plastics, Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic, Rubber Parts, Tolerances.

Self-study component:	Design Recommendations for Rubber Parts.

UNIT – IV	**Optimization in Design**	**8 Hours**

Optimization in Design: Introduction, Siddal's Classification of Design Approaches, Optimization by differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design.

Economic Factors Influencing Design: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Economics of New Product Design (Samuel Eilon Model)

Self-study component:	. Break-even Analysis.

UNIT – V	**Value Engineering and Product Design**	**8 Hours**

Value Engineering and Product Design: Introduction, What is Value? Nature and Measurement of Value, Maximum Value, Importance of Value, The Value Analysis Job Plan, Creativity, Steps to Problem-solving and Value analysis, Value Analysis Test, Value Engineering Idea Generation Check-list. Material and Process Selection in Value Engineering.

Self-study component:	Historical Perspective of Value Engineering.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Describe, Interpret** and **Apply** the fundamental concepts of product design and manufacturing and the role of tolerance in product design.	Remember	L1
CO2	**Demonstrate** the types of models designed by industrial engineer and role of aesthetic, Function and strength, stiffness and rigidity considerations in product design.	Understanding	L2
CO3	**Select** the different materials based on the functions of the product and complexity involved.	Understanding	L2
CO4	**Explain** the optimization parameters used for design and ergonomic factors influencing the success of the product.	Remember	L1
CO5	**Analyze** the role of Material handling and Selection for product and how to add value to the product.	Understanding	L2

Text Book(s):

1. A.C. Chitale and R.C. Gupta, "Product Design and Manufacturing", PHI.
2. Karl T. Ulrich & Steven D., Epinger, "Product Design & Development", Tata McGraw Hill, 3rd Edition, 2003.

Reference Book(s):

1. Tim Jones, Butterworth Heinmann, "New Product Development", Oxford, UIC -1997.
2. Roland Engene Kinetovicz, New Product Development- Design & Analysis- John Wiley and Sons Inc., N.y. -1990.

Web and Video link(s):

1. https://www.youtube.com/watch?v=9WPZStQp03Q&list=PLSGws_74K01-KPzaLUtCV7R-CognwVoP8
2. https://www.youtube.com/watch?v=v8Cfury5phw&list=PLLy_2iUCG87DWm2TcXTGjqppfX0Cy4O7c&index=17
3. https://www.youtube.com/watch?v=uc45DrIDHQ&list=PLLy_2iUCG87DWm2TcXTGjqppfX0Cy4O7c&index=3

E-Books/Resources:

1. https://drive.google.com/file/d/1pJgQGaH0m9gA7vMbe65CwvUQKLzg4OY4/view?pli=1
2. https://drive.google.com/file/d/1xUulQFSCVjpqXeG8bcPwsxKi9nWl_Rjf/view
3. https://drive.google.com/file/d/1lNSDUvyrLnqNTrV2CRLXxcWjIRV0LvW3/view
4. https://drive.google.com/file/d/1vB4JTL3Dur8cp-v_jrsNLODb3-RxTz0Y/view

MATERIALS MANAGEMENT [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the concept value of material handling and purchase management.
- Understand inventory management techniques.
- Define the concepts of EOQ and Inventory systems.
- Understand the applications of information system and productivity in material management.

UNIT – I	**Introduction and Purchasing Management**	**8 Hours**

Introduction to materials management: Role, scope and importance of material control function, materials management in organization, cost aspects, materials management organization, specifications of materials, Advantages in integrated MM concept, waste control and materials research.

Purchasing Management: Importance and goals of Purchasing**,** Purchase systems, Pre purchase system, Ordering system.

Self-study component:	Post purchase system and Special purchasing systems.

UNIT – II	**Stores Management and Materials Handling**	**8 Hours**

Stores Management: Layout of stores, Purpose of stores, Cost aspects and Productivity, Problems and development, new developments in storing.

Materials handling: Influencing factors and control, Equipment's, Evaluation of material handling, definition and scope.

Self-study component:	Value Analysis Origin.

UNIT – III	**Inventory management and techniques**	**8 Hours**

Inventory management and techniques: Introduction, Raw material, WIP, Finished goods, Norms for inventory, Peculiars in India, Relevant costs, cost of ordering, cost of inventory carrying.

Self-study component:	Understocking cost and overstocking cost

UNIT – IV	**EOQ and Practical Inventory Systems**	**8 Hours**

Economical Ordering quality: Static risk model, Dynamic certain model (EOQ), Cost sensitivity analysis, Importance of EOQ

Practical inventory systems: Systems design, Q-system, P-system, 8s optional replenishment system

Self-study component:	Safety Stock.

UNIT – V	**MIS and Materials Management**	**8 Hours**

Materials management information system and computer: MIS management and MM computer system for MIS and MM. In process materials and Management control

Materials management and Productivity Production, Productivity and modern industry, Interrelationship of profitability and productivity.

Self-study component:	Total organizational effectiveness.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Describe** scope and importance of material and purchasing management	Remember	L1
CO2	**Analyse** value of material handling and store management	Understanding	L2
CO3	**Describe** the inventory management techniques.	Remember	L1
CO4	**Illustrate** concepts of EOQ and Inventory systems.	Applying	L3
CO5	**Explain** applications of information system and productivity in material management.	Understanding	L2

Text Book(s):

1. "Materials Management-Integrated approach", P.Gopalakrishnan, M.sundaresan, Published by Prentice Hall of India Private limited, 2017.
2. "Materials Management-Procedures", Text and cases, 2nd edition by AK.Datta, PHI learning private limited, 2010.

Reference Book:

1. **"**Introduction to Materials Management" by Sterechapman, Tony k.Arnold, Ann.K.Gatewood, Cloyd Clive., 7th edition, published by Pearson, 2012.

Web and Video link(s):

1. PURCHASING | PURCHASE MANAGEMENT | PRODUCTION MANAGEMENT | OPERATION MANAGEMENT| STOCKLESS & BLANKET - YouTube
2. Stores Management||Meaning||Types Of Stores||Objective||Functions||Methods Of Management||MBA||BBA - YouTube

E-Books/Resources:

1. Microsoft Word - Final PM version 7.3 - 4Print.docx (chalmers.se)
2. Purchasing and Supply Chain Management, 4th ed (mim.ac.mw)

THEORY OF METAL FORMING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6024**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Explain different types of Forging and Rolling Process and their Defects.
2. Explain the role of Extrusion Equipment in used in Extrusion process and wire and Tube drawing Process.
3. Describe the shearing, blanking, punching, and bending of sheet metal.
4. Explain the HERF and Steps in Powder Metallurgy Process.

UNIT – I	**Fundamentals of Metal working**	**8 Hours**

Fundamentals of Metal working: Classification of forming processes, Mechanics of Metal working – slab method, flow stress determination, temperature in Metal working, Hot working, Cold working, Warm working, strain rate effects, metallurgical structure, friction and Lubrication.

Self-study component:	*Residual stresses in Metal Forming*

UNIT – II	**Forging and Rolling**	**8 Hours**

FORGING: Classification of forging operation, forging equipment, , open die forging, closed die forging and forging defects.
ROLLING: Classification of rolling mills- hot and cold. Rolling forces and, simplified analysis of rolling load, defects in rolled products.

Self-study component:	*Precision and Powder Metallurgy Forging process, Applications of Cluster and planetary Mills.*

UNIT – III	**Extrusion, Drawing of Rods, Wires and Tubes**	**8 Hours**

EXTRUSION: Classification, equipment's used, hot extrusion, deformation, lubrication and defects in extrusion, analysis of extrusion processes, hydrostatic extrusion, production of seamless pipe and tubing, Extrusion defects.
DRAWING OF RODS, WIRES AND TUBES: Rod and wire drawing process, drawing dies, analysis of wire drawing, wire and tube drawing. Defects in drawing, tube drawing.

Self-study component:	*Impact extrusion, Residual Stresses in Rods, Wires and Tubes.*

UNIT – IV	**Sheet Metal Forming Process**	**8 Hours**

SHEET METAL FORMING PROCESS: Introduction, Forming methods, shearing, blanking, punching, bending, spring back, elimination of spring back, spinning, deep drawing stretch forming, redrawing, reverse drawing, defects in drawing, factors affecting drawability ratio.

Self-study component:	. The application of sheet metal working in various sectors

UNIT – V	**HERF and Powder Metallurgy**	**8 Hours**

HIGH ENERGY RATE FORMING (HERF): Introduction to HERF, Process advantages, explosive forming, electro discharge forming and electromagnetic forming, Rubber forming.

POWDER METALLURGY: Basic steps in Powder metallurgy brief description of methods of production of metal powders, advantages and limitations.

Self-study component:	Principle of HERF Process**,** Characteristics of Metal powders.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the theory behind the forming of the metal.	Remember	L1
CO2	**Understanding** of various metal forming processes, such as forging, rolling, extrusion, drawing, and sheet metal forming. They will learn about the principles, mechanics, and characteristics of each process	Understanding	L2
CO3	**Optimize** the parameters to achieve desired forming results and mechanical properties.	Understanding	L2
CO4	**Analysis** of Forming Defects and troubleshooting: common defects that may occur during metal forming processes	Applying	L3
CO5	**Knowledge** of Advanced Forming Techniques such as incremental forming, hydroforming, HERF	Remember	L1

Text Book(s):

1. Mechanical Metallurgy - Dieter. G. E - McGraw Hill, 2015.
2. Manufacturing Process III, Radhakrishna K, Sapna Book House 2013.

Reference Book(s):

1. ASM- Metals handbook, Sach G. fundamentals of working of metals, Pergamon Press.
2. Manufacturing Engineering and Technology by Serope Kalpakjian & Stevan

Web and Video link(s):

1. https://archive.nptel.ac.in/courses/112/107/112107250/
2. https://archive.nptel.ac.in/courses/113/106/113106098/
3. https://www.youtube.com/watch?v=0jAxB_vT12k

E-Books/Resources:

1. https://drive.google.com/file/d/1PAeda49cpGCS6W41zIf9eHdzwQh58SvK/view

ENGINEERING ECONOMICS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Illustrating the basics of Economics and the Interest & the various Interest factors
- Analyzing the various projects using Present worth and Equivalent annual comparison methods
- Determining the Rate of return and Depreciation of various Projects/Assets
- Comparing the different Alternatives & Replacement criteria in the back ground of inflation, time value of money & Sources of capital
- Computing the cost of a product/project & assessing the Breakeven point

UNIT – I	**Introduction, Interest and Interest Factors**	**8 Hours**

INTRODUCTION: Engineering Decision- Makers, Engineering decision makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Economics models.

INTEREST AND INTEREST FACTORS: Interest rate, simple interest Compound interest, effective interest rates, Cash- flow diagrams, continuous compounding and compound-interest factors, Exercises and problem solving.

Self-study component:	Sensitivity and Sub optimization.

UNIT – II	**Present worth Comparison**	**8 Hours**

PRESENT WORTH COMPARISON: Conditions for present worth comparisons, Present worth comparisons method, Basic Present worth comparisons patterns, Assets that have unequal lives, infinite lives, Pay – back comparison, Exercises and problem solving.

Self-study component:	Future worth comparisons

UNIT – III	**Equivalent Annual worth Comparisons**	**8 Hours**

EQUIVALENT ANNUAL WORTH COMPARISONS: Why Annual Worth Comparison? Revenue dominated CFD, cost dominated CFD, Situations for EAW Comparisons, consideration of Asset life, use of sinking Fund. Exercises and problem solving.

Self-study component:	Comparison Between Present Worth and Future Worth.

UNIT – IV	**ROR Calculations and Depreciation**	**8 Hours**

RATE OF RETURN CALCULATIONS: Rate of return, calculation of IRR, Minimum acceptable rate of return,

DEPRECIATION: Causes of Depreciation, Basic methods of computing depreciation charges: Straight-line, Declining balance, Sum-of the Years-Digits & Sinking fund Methods.

Self-study component:	*. Tax concepts and types.*

UNIT – V	**Estimation, Cost Analysis and Financial Management**	**8 Hours**

ESTIMATING & COSTING: Introduction to costing, costing procedure, components of cost, selling price method, Allocation of overheads, and Estimation for simple components.
REPLACEMENT ANALYSIS: Deterioration, obsolescence, inadequacy
EFFECTS OF INFLATION: Causes, consequences and control & Measuring of inflation, Lease or Buy decisions
BREAK-EVEN ANALYSIS: Basic Concepts, Linear break even analysis, Exercises and problem solving**.**

FINANCIAL MANAGEMENT: Types of capital, Cost of capital concept			
Self-study component:	*Sources of Finance, purpose of Investment*		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the fundamentals of the Engineering economics.	Understanding	L2
CO2	**Compare** the various Project(s) using present worth/ Equivalent Annual worth methods.	Applying	L3
CO3	**Compute** the Rate of return of the Project(s) and Depreciation charges of the Machine/Equipment	Applying	L3
CO4	**Analyze** the various alternatives & criteria of replacement, Sources of capital and predict the effect of inflation on it	Applying	L3
CO5	**Estimate** the cost of a product/process and Judging the Breakeven point	Applying	L3

Text Book(s):

1. Engineering economics- James L.Riggs and others , 4th edition, Tata McGraw Hill, 2015 Reprint
2. Engineering economics- R.K.Hegade, Sapna Book house, 1st edition, 2015 Reprint.

Reference Book(s):

1. Engineering economy -THUESENH.G. PHI, 2002
2. Engineering Economy – NVR. NAIDU, KM BABU and G. RAJENDRA, New Age International Pvt. Ltd. – 2006
3. Engineering economics- K.R.Phaneesh, Sudha Publications, 3rd revised edition, 2008.

CELLULAR MANUFACTURING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21IP6032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Illustrating the basics of Cellular Manufacturing Process.
- Analyzing the cell formation techniques used in the cellular manufacturing process.
- Enlightening the importance of processing the exceptional components.
- Evaluation of Static Cells, Selection of Solutions used in the cellular manufacturing process
- Computing the various line balancing technique used in the cellular manufacturing process

UNIT – I	**Cellular Manufacturing**	**8 Hours**

Cellular Manufacturing: Introduction, Group machining Concept, Principle, Terminology, characteristics, Perspectives, Objectives, Techniques, Applications, Factors to be considered for implementation, factors influencing the success of cellular manufacturing.

Self-study component:	Application, Advantages and Disadvantages of Cellular Manufacturing.

UNIT – II	**Cell Formation Techniques**	**8 Hours**

Cell Formation Techniques: Design and Manufacturing Attributes, Cell Design and Representation of the Problem. Cell Formation Techniques – Traditional methods, Similarity coefficient methods, Array based methods. Cell Design Considerations, Data Structure and Influence on the Solution.

Self-study component:	Rank Order Clustering Method

UNIT – III	**Processing the Exceptional Components**	**8 Hours**

Processing the Exceptional Components: Introduction, Processing Exceptional Components, and Models for Eliminating Exceptional Components.

Self-study component:	Part Families.

UNIT – IV	**Evaluation of Cellular Manufacturing Solutions**	**8 Hours**

Evaluation of Cellular Manufacturing Solutions: Introduction, Static Evaluation of Cells, Measure of flexibility (MF), Selection of Solution, VEDO Analysis, Comparison of Different Methods.

Self-study component:	Cell Scheduling and Sequencing.

UNIT – V	**Technical Acoustics**	**8 Hours**

Line Balancing in Cellular manufacturing: Line balancing for cells, Design Factor in Line Balancing, Bowl Phenomena in Cellular Manufacturing environment, effect on production rates.

Self-study component:	Production Flow Analysis.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Outline** the Principle and Implementation Factors required to Implement Cellular Manufacturing Technique for the Industries.	Remember	L1
CO2	**Describe** the Various Cell Formation Techniques.	Analyzing	L2
CO3	**Explain** the Processing the Exceptional Components.	Understanding	L2
CO4	**Illustrate** the Evaluation of Cellular Manufacturing Solutions	Applying	L1
CO5	**Analyze** the Line Balancing in Cellular Manufacturing Techniques.	Analyzing	L3

Text Book(s):

1. Cellular Manufacturing Systems: Design, planning and control by N Singh and D Rajamani, Springer Publication ISBN 1461285046
2. Cellular Manufacturing-Mitigating Risk and Uncertainty by John X. Wang Routledge, Taylor and Francis Group ISBN 9780367783617.

Reference Book(s):

1. Cellular Manufacturing Systems: An Integrated Approach by B.S. Nagendra Parashar, PHI Publications.
2. Cellular Manufacturing: Integrating Technology and Management by John A. Brandon, Research Study Press, ISBN 0863801919.

Web and Video link(s):

1. https://www.youtube.com/watch?v=TBNqKykJ0no
2. https://www.youtube.com/watch?v=zp9ydn-uQao
3. https://www.youtube.com/watch?v=YoslM2Sxihs

E-Books/Resources:

1. https://nptel.ac.in/courses/110106044

NANOTECHNOLOGY [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explaining the basics of Nanostructures, Nano Particles and Nano Crystalline Materials.
- Discuss about the various synthesis method to synthesize the Nano Materials.
- Enlightening the Properties of Nano Materials.
- Computing the Characterization and Application of Nano Materials.

UNIT – I	**Introduction**	**6 Hours**

Introduction: Definition and Classification of Nanostructures -Nano Particles, Nano crystalline Materials, Nano-crystalline Ceramics, Semiconductor Nanoparticles, Metal Nanoparticles, Nanotubes and Nano - Scale Architectures.

Self-study component:	*Carbon Nano Tubes*

UNIT – II	**Synthesis of Nano Materials**	**9 Hours**

Synthesis: Top down approaches and bottom up approaches. Chemical methods: sol-gel synthesis, Co-precipitation, CVD, CVS, and combustion synthesis. Microwave Synthesis of Metallic nano Particles (Ag, Au, pt) and Nanoparticles of Metal Oxides (ZrO_2, ZnO, Al_2O_3, TiO_2). Carbon Nanotubes -Synthesis Multi-Walled Nanotubes Aligned Carbon Nanotube Bundles Single-Walled Carbon Nanotubes. Physical methods: Vapor deposition and different types of epitaxial growth techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography photolithography, soft lithography.

Self-study component:	Micromachining.

UNIT – III	**Properties of Nano Materials**	**8 Hours**

Properties: Effects of nanometer length scale on Physical and Chemical Properties of Materials. Size Effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States. Chemical properties- catalysis.

Self-study component:	Role of Catalysis.

UNIT – IV	**Characterization**	**9 Hours**

Characterization: XRD-X-ray powder diffraction – Bragg's law - Instrumentation. Determination of lattice parameters - particle size analysis using Scherer formula. SEM-Working Principle of Specimen Preparation – Modes of operation– Backscattered electrons – secondary electrons- X-rays – typical forms of contrast– Resolution and contrast – enhancement –Analyses of SEM images. TEM-Basic principles - Modes of operation – Specimen preparation – Diffraction in imperfect crystals and dislocations.

Self-study component:	Structure of Grain boundaries and interfaces- HRTEM

UNIT – V	**Applications of Nano Materials**	**8 Hours**

Applications: Renewable energy, solar energy, fuel cells. Materials manufacturing and automobile industry. Biomedical Science, Medicine, Diagnostics. Biotechnology. Computers, Electronics and communication. Chemical analysis, Pharmacy Environmental sciences, Sport sector, Printing, Optics. Agriculture, Food, Textile, Cosmetics. Defense.

Self-study component:	Aerospace and Marine Nanotechnology.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Outline** the Classification of Nano Particles.	Remember	L1
CO2	**Describe** the Various Synthesis Method to Manufacture the Nano Materials.	Understanding	L2
CO3	**Explain** the Properties of Nano Particles.	Understanding	L2
CO4	**Analyze** the Characterization of Nano Materials	Applying	L3
CO5	**Narrate** the Various Applications of Nano Materials.	Remember	L1

Text Book(s):

1. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, the Chemistry of Nanomaterials: Synthesis, Properties and Applications, Volume 1, Wiley-VCH, Verlag GmbH, Germany (2004).

Reference Book(s):

1. G.A. Ozin and A.C. Arsenault, "Nanochemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
2. Charles P.Poole Jr. "Introduction to Nanotechnology", John Willey & Sons, 2003. T. Pradeep
3. "NANO the Essential, understanding Nanoscience and Nanotechnology". Tata McGraw-Hill
4. Nano scale Science and Technology Robert Kelsall, Ian Hamley, and Mark Geoghegan (Editors) John-Wiley.

Web and Video link(s):

1. https://www.youtube.com/watch?v=0EWCqCIsFOA
2. https://www.youtube.com/watch?v=Z51R49OOqAA
3. https://www.youtube.com/watch?v=lFYs3XDu4fQ
4. https://www.youtube.com/watch?v=0EWCqCIsFOA&list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ

E-Books/Resources:

1. https://drive.google.com/file/d/1ug4enjbji1x3PRDzFFxJ7vqkaIVoKv2_/view
2. https://drive.google.com/file/d/125d4_cbUp2Dv-AshH7X6CGe4oRnQyCb5/view

THEORY OF METAL CUTTING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the mechanism of metal cutting principles and formation of chips in different types of metals. Explain the terminology of Single Point and Multi Point cutting tools.
- Explain the cutting forces involved and their relationship with respect to the resultant force in orthogonal metal cutting process.
- Describe the concept of Machinability and Economics of Machining.
- Explain the effect of temperature in metal working and the purpose and types of lubricants used in the process.
- Explain the properties of different types of materials used in manufacturing tools and their properties.

UNIT – I	**PROCESS OF METAL CUTTING**	**8 Hours**

PROCESS OF METAL CUTTING: Metal Cutting, Metal Cutting Principle, Types of Metal Cutting Process, Chip Formation, Chip Thickness Ratio, Chip Breaker, Cutting Speed, Feed and Depth of Cut – Economical cutting speed, Tool Geometry – Single Point Cutting Tool and Multipoint Cutting Tool (only drill bit).

Self-study component:	Effect of cutting parameters on Tool Geometry

UNIT – II	**MECHANICS OF METAL CUTTING**	**8 Hours**

MECHANICS OF METAL CUTTING: Cutting forces in Orthogonal Cutting, Stress and Strain in the Chip, Shear Strain, Work done and Power required, Power Consumed in Metal cutting, Merchant's Circle diagram and analysis, Co-efficient of friction Dynamometry, Types of Dynamometers (Mechanical, Lathe tool and Milling).

Self-study component:	Hydraulic and pneumatic dynamometers

UNIT – III	**TOOL WEAR AND TOOL LIFE**	**8 Hours**

TOOL WEAR AND TOOL LIFE: Machinability, Machinability Index, Objectives of Machining. Tool Failure-types of tool wear, Tool Life, e, Effect of Feed and Depth of cut on Tool Life. Economics of Machining - Basic Objectives of Economical Machining, Production Cost, Economic Tool Life, Optimum Cutting Speed for Maximum Production, Tool Life for Maximum Profit.

Self-study component:	Cost Analysis – Cost per Component

UNIT – IV	**CUTTING FLUIDS**	**8 Hours**

CUTTING FLUIDS: Cutting Fluids, Sources of Heat in Metal Cutting, Thermal Aspects of Metal Machining, Functions of Cutting Fluids, Types of Cutting Fluids, Selection and Application of Cutting Fluids, Effect of Cutting Fluid on Cutting Speed and Tool Life, Recommended Cutting Fluids and Reuse of Cutting Fluids. Factors Affecting Heat Generation, Measurement of Temperature- Tool Work Thermocouple Technique.

Self-study component:	Temperature Distribution in Metal Cutting

UNIT – V	**TOOL MATERIALS AND THEIR PROPERTIES**	**8 Hours**

TOOL MATERIALS AND THEIR PROPERTIES: Characteristics of tools materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, sialon, CBN, UCON, recommended cutting speeds for the above tools, tool & die steels – air, water, oil hardening of tools and their applications.

Self-study component:	Composite Tools

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Identify** the metal cutting process and its process parameters, cutting tool geometry term to solve real time metal cutting problems	Understanding	L2
CO2	Make use of fundamentals of manufacturing process to **describe** the constructional features and working of various machine tools and different metal working process	Understanding	L2
CO3	**Identify** the tool life based on different cutting speed, feed and depth of cut and understand the importance of economy in machining.	Understanding	L2
CO4	**Understanding** of different types of Cutting Fluids and Lubrication of metal cutting processes and their role in reducing tool wear, dissipating heat, and improving surface finish, different types of cutting fluids, their properties.	Understanding	L2
CO5	**Explain** the characteristics and properties of different tool material.	Remember	L1

Text Book(s):

1. Fundamentals of Metal Cutting and Machine Tools, B. L Juneja and G. S. Sekhon, Willy Eastern Limited, 2015
2. Tool Engineering and Design-G. R. Nagpal, Khanna Publishers -6TH Edition.

Reference Book(s):

1. Metal cutting theory, Black P. H, MC Graw Hill, 1996.
2. Metal cutting theory and cutting tool design, Arshinov and Atekseev, Mir Publishers, 1976.
3. Fundamentals of Machining and Machine Tools", R. K. Singal, I K International Publishing house Pvt. Lt, 2008.
4. Metal Cutting Principles, M. C. Shaw Oxford & I.B.H, 1st Edition.
5. Metal Cutting and Tool Design", Dr. B. J. Ranganath, Vikas Publishing House, 1999.

Web and Video link(s):

1. https://youtu.be/ySF7C2NM254
2. https://archive.nptel.ac.in/courses/112/105/112105306/

E-Books/Resources:

1. https://drive.google.com/file/d/1K10OU-GZbqc5ogT4AOUOkZxN2sTs_iuh/view
2. https://drive.google.com/file/d/1nNED3k6kwrctMqcg6nbciqQPbKd9KWwj/view
3. https://drive.google.com/file/d/1bCg7M1a-EfTbKIIbBc-Azffq-DaLLnQx/view

COMPUTER AIDED DESIGN AND MANUFACTURING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP604**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Able to define CAD and CAM and the product cycle in conventional and computerized manufacturing environment.
- Able to understand basic hardware structure, types of hardware and input and output devices.
- Able to understand NC, CNC, & DNC technology.
- Able to understand CNC, tools, write programming and solve the problems.
- Able to understand CNC programming and solve the problems.

UNIT – I	**Introduction**	**8 Hours**

INTRODUCTION: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional & computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.

Self-study component:	Input and Output devices – Hardware in CAD.
Practical Topics: **Minimum 2 and Maximum 3 Experiments in each Unit**	1. Introduction – G and M Codes, Basics of Programming 2. Writing and execution of manual part programming using ISO codes.

UNIT – II	**COMPUTER GRAPHICS**	**8 Hours**

Software configuration of a graphic system, function of a Graphics package, construction of geometry, wire frame and solid modelling, Geometric 2D and 3D homogeneous transformations with simple problems (problems on 2D transformations).

Self-study component:	Basic features of IGES, STEP, DXF, and DMIS.
Practical Topics: **Minimum 2 and Maximum 3 Experiments in each Unit**	1. Writing and execution of part program for profile and pocket Milling. 2. Writing and execution of part program for Drilling.

UNIT – III	**NC, CNC, DNC TECHNOLOGY**	**7 Hours**

NC, CNC, DNC modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.

Self-study component:	Applications of CNC and DNC.
Practical Topics: **Minimum 2 and Maximum 3 Experiments in each Unit**	1. Application of Tool radius compensation. 2. Demonstration of basic CAD-CAM systems.

UNIT – IV	**CNC Machine Tools and Programming**	**9 Hours**

CNC MACHINE TOOLS: Turning tools geometry, milling tooling systems, tool presetting, ATC, work holding. CNC machine tools, Overview of different CNC machining centres, CNC turning centres, high speed machine tools.

CNC PROGRAMMING: Part program fundamentals – steps involved in development of a part program. Manual part programming-milling & turning with problems.

Self-study component:	Contouring – Types and Uses.

Practical Topics: **Minimum 2 and Maximum 3 Experiments in each Unit**	1. Generation of tool path from product geometry using CAD CAM simulation tools – MasterCAM. 2. Simple Problems on Milling and Drilling.

UNIT – V	**Group Technology, Flexible Manufacturing and Industrial Robots**	**8 Hours**

GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING: Part families, Part classification & coding, Machine cell design & benefit of GT, FMS work stations, planning the FMS, FMS layout configuration.
INDUSTRIAL ROBOTICS: Introduction, Robot Configuration, Robot Motions, End effectors, Robot Sensor, Robot Applications.

Self-study component:	**A**pplication and benefit of FMS
Practical Topics: **Minimum 2 and Maximum 3 Experiments in each Unit**	1. Programming of robots by manual, lead through and off line methods. 2. Use of robot programming languages to pick and place, stacking of objects in increasing or decreasing size. 3. Experiment on robot programming and simple sensor experimentation.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Ability to **apply** knowledge in the field design & manufacturing with help of CAD / CAM	Remember	L1
CO2	Ability to **learn** concepts of graphics package regarding 2D & 3D transformations.	Understanding	L2
CO3	Ability to **learn** concepts of NC, CNC & DNC technology. And also known CNC machine tool & tooling system.	Understanding	L2
CO4	Ability to **develop** steps for CNC part programming and able to solve the problems.	Applying	L3
CO5	Ability to **known** in detail the group technology & coding system also should know FMS technology.	Applying	L3

Text Book(s):

1. **CAD / CAM Principles and Applications**- P.N. Rao, TMH, New Delhi, 2002.
2. **CAD/CAM –** Mikell P Groover, Emory W. ZimrnersJr Pearson Education Inc, 2003.
3. **Automation, production systems and computer integrated Manufacturing** – Mikell P. Groover.

Reference Book(s):

1. **Principles of Interactive Computer Graphics** - Newman and Sproull, Tata McGraw Hill, 1995.
2. **NC Machine programming & software Design** -Chno-Hwachang, Michel.A. Melkanoff, Prentice Hall, 1989.
3. **Computer Graphics** -Steven Harrington, McGraw Hill Book Co.
4. **Computer Aided Manufacturing** - P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 1999.
5. **Basic Computer Aided Geometric Design** - Ganesh. M – I. K. International, New Delhi – 2008

Web and Video link(s):

1. What is NC/ CNC/ DNC Machine? Difference between NC/CNC/DNC Machine?
2. CAD/CAM/NC/CNC, Additive Manufacturing, Transformation | Complete Revision of All Topics | Kuldeep - YouTube
3. Industrial Robots: Introduction, Anatomy, Degree of freedom, applications, Sensors,Drives, Grippers - YouTube

E-Books/Resources:

1. vica3.p65 (uvic.ca)
2. Industrial Robotics - What are Industrial Robots? | VEX Education
3. CNC Machine Programming Course.pdf (indianrailways.gov.in)

JUST IN TIME MANUFACTURING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21IP6051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Illustrate the basics of JIT manufacturing and its implementation at Toyota.
- Discussing about the method of achieving the Production smoothing in JIT,
- Summarize the JIT implementation in different type of organizations and at different countries.
- Telling the Design, development and management of JIT manufacturing systems.
- Develop the Supply management systems for JIT manufacturing systems.
- Design the framework for implementing the JIT manufacturing systems.

UNIT – I	**JIT and Modern Production System**	**8 Hours**

JIT - Introduction: The new production system research association of Japan, some definitions of JIT, core Japanese practices of JIT, basic elements of JIT, benefits of JIT

Modern Production System: Philosophy of Toyota's production system, basic framework of Toyota production system. KANBAN SYSTEM – other types of kanbans, kanban rules, adapting to fluctuations in demand through kanban, whirligig.

Self-study component:	Kanban System

UNIT – II	**Production Smoothing In Toyota Production System**	**8 Hours**

Production Smoothing In Toyota Production System: production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production. EDP system for support of the Toyota Production system, Shortening lead time in Toyota Production system, reducing the setup time.

Self-study component:	Some comparisons with other manufacturers.

UNIT – III	**Global Implementation Of JIT**	**8 Hours**

Global Implementation Of JIT: JIT in automotive industry, JIT in electronics, computer, telecommunication and instrumentation, JIT in process type industry. JIT in service and administrative operations, conclusion.

Jit Implementation Surveys: JIT implementation in US manufacturing firms-analysis of survey results, just in time manufacturing in UK industries and in West Germany, Conclusion.

Self-study component:	JIT in seasonal demand industry.

UNIT – IV	**Design, Development And Management of JIT Manufacturing Systems**	**8 Hours**

Design, Development And Management of JIT Manufacturing Systems: plant configurations and flow analysis for JIT manufacturing, comparison of JIT's "demand pull" system with conventional "push type" planning and control systems, quality management system for JIT, product design for JIT, human resource management in JIT, flexible workforce system at Toyota, creation and maintenance of teams for JIT.

Self-study component:	Product costing information systems in JIT manufacturing, an example of overhead allocation in JIT

UNIT – V	**Supply Management For JIT**	**8 Hours**

Supply Management For JIT: JIT purchasing-the Japanese way, some studies in JIT purchasing, surveys on JIT purchasing, buyer-seller relationship in JIT purchasing, Quality certification of suppliers in JIT purchasing, some problems in implementation of JIT purchasing, reduction freight costs in JIT purchasing, monitoring supplier performance for JIT purchasing.

Self-study component:	Audit in JIT purchasing.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the JIT Manufacturing and its implementation at Toyota	Understanding	L2
CO2	**Illustrating** the method of achieving the Production smoothing in JIT.	Understanding	L2
CO3	**Analyzing** the JIT implementation in different type of organizations and at different countries.	Understanding	L2
CO4	**Design**, development and management of JIT manufacturing systems	Applying	L3
CO5	**Preparing** the Supply management systems and constructing the framework for implementing the JIT manufacturing systems.	Applying	L3

Text Book(s):

1. **Just In Time Manufacturing-** M.G. Korgaonker, Macmillan India Ltd.- 1992,
2. **Japanese Manufacturing Techniques** -Richard J. Schonberger, The Free Press – Macmillan Pub. Co., Inc. New York - 1988.

Reference Book(s):

1. Just-in-Time Manufacturing: An introduction by T C E Cheng, Springer, ISBN 0412735407

Web and Video link(s):

1. https://www.youtube.com/watch?v=HkdoR-NNEoI
2. https://www.youtube.com/watch?v=MOUVgjp73k0

E-Books/Resources:

1. https://drive.google.com/file/d/1GpNH74T_4BEswTTD9v1qp8FUdkK5L98-/view

FLEXIBLE MANUFACTURING SYSTEMS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Illustrate the basics of Flexible manufacturing and its applications.
- Discussing about the role of Computers in FMS.
- Analyze the FMS Simulation and Data Base.
- Explain the Concept of Group Technology.

UNIT – I	**Planning, Scheduling And Control Of Flexible Manufacturing Systems**	**8 Hours**

Planning, Scheduling And Control Of Flexible Manufacturing Systems: Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility – single product, single batch, n – batch scheduling.

Self-study component:	Advantages of FMS

UNIT – II	**Computer Control And Software For Flexible Manufacturing Systems**	**8 Hours**

Computer Control And Software For Flexible Manufacturing Systems: Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control.

Self-study component:	Role of Computer in FMS

UNIT – III	**FMS Simulation And Data Base**	**8 Hours**

FMS Simulation And Data Base: Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database.

Self-study component:	Data Flow Analysis in FMS

UNIT – IV	**Group Technology And Justification Of FMS**	**8 Hours**

Group Technology And Justification Of FMS: Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS.

Self-study component:	Advantages of Group Technology

UNIT – V	**Applications Of FMS And Factory Of The Future FMS**	**8 Hours**

Applications Of FMS And Factory Of The Future FMS: Application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS

Self-study component:	FMS in Indian Industries.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the Flexible Manufacturing System and its implementation at Various Manufacturing Industries.	Remember	L2
CO2	**Illustrating** the Role of Computers in FMS.	Understanding	L1
CO3	**Analyzing** the FMS Simulation and Data Analysis.	Understanding	L3
CO4	**Design** the Group Technology in FMS Related Industries	Applying	L3
CO5	**Outline** the Applications of FMS in Industries.	Remember	L1

Text Book(s):

1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

Reference Book(s):

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New AgeInternational Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.
3. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, "Toyota Production System: Beyond large-scale Production", Productivity Press (India) Pvt. Ltd. 1992

Web and Video link(s):

1. https://www.youtube.com/watch?v=WiEDRWyhEik
2. https://www.youtube.com/watch?v=kgCMJIVI5XE
3. https://www.youtube.com/watch?v=uhl4jEQT_aQ

E-Books/Resources:

1. https://drive.google.com/file/d/1oboWWB1ezE_2f8MHpH8dT01T5EznycsT/view
2. https://drive.google.com/file/d/1mkadYYVnajmb1b-xQjib3gPrKapp8awV/view
3. https://drive.google.com/file/d/10-vhtrGuyL3isZcgZMYzc3O3MXYg_LCR/view

PROJECT MANAGEMENT [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the concept of project management and the steps in the process.
- Understand the functions of project management.
- Define the concept and methods used in project management techniques.
- Understand the Authorities and responsibilities of project manager.
- Understand Project evaluation and review Techniques (PERT) Planning.
- Understand the Performance improvement for the CM & DM companies for better project management.

UNIT – I	**Project Management, Planning and Estimation**	**8 Hours**

Concepts Of Project Management: Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibility of project leader.

Project Planning and Estimating: Feasibility report phased planning, Project planning steps, Objective and goals of the project, preparation of cost estimation, and evaluation of the project profitability.

Self-study component:	Tools and techniques for project management.

UNIT – II	**Organizing and Staffing The Project Team**	**8 Hours**

Organizing and Staffing The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution, controls.

Self-study component:	Tendering and selection of contractors.

UNIT – III	**Project Scheduling**	**8 Hours**

Project Scheduling: Project implementation scheduling, effective time management, different scheduling techniques,

Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management.

Self-study component:	Resources allocation method.

UNIT – IV	**Co-Ordination and Control**	**8 Hours**

Co-Ordination and Control: Project direction communication in a project, MIS project co-ordination, project control requirement for better control of project or role of MIS in project control, cost Control.

Self-study component:	Performance control and schedule control.

UNIT – V	**Performance Measures in Project Management**	**8 Hours**

Performance Measures In Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management.

Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.

Self-study component:	Project management and environment.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Defining** the concept of project management and the steps of the process.	Remember	L1
CO2	**Understanding** the functions of project management.	Understanding	L2
CO3	**Illustrating** the concept and methods used in project management techniques.	Applying	L3
CO4	**Outlining** the duties, authorities and responsibilities of project manager	Remember	L1
CO5	**Planning** the performance measures in project management.	Remember	L1

Text Book(s):

1. Project Management a System approach to Planning Scheduling& Controlling- Harold Kerzner, CBS Publishers and Distributors. 2002.
2. Project Execution Plan: Plan for project Execution interaction-Chaudhry S., 2001.

Reference Book(s):

1. Project Management – Beningston Lawrence McGraw Hill 1970.
2. A Management Guide to PERT and CPM, WEIST&LeVY EasternEconomy of PH 2002. PERT &CPM.L.S.Srinnath, Affiliated East WestPress Pvt. Ltd. 2002.
3. Project planning analysis selection implementation &reviewprasannachandra, ISBNO-07-462049-5 2002.
4. Planning, Performing and Controlling- Angus, Project, 3rd End,Person Education, ISBN:812970020m, .2001
5. Project planning scheduling & control- jamesP.Lawis, MeoPublishing Company, 2001.
6. Project Management- Bhavesh M.Patel, ,Vikas Publishing House,ISBN 81-259-0777-7, 2002

PRODUCTION PLANNING AND CONTROL [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21IP6054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the concept of Production planning control and productivity.
- Understand the Objectives of plant layout and Plant location.
- Understand Applications of computers in production control.
- Define the concept of Record Management and Mechanizations

UNIT – I	**PPC and Production Planning**	**8 Hours**

Production planning control: Introduction, Forecasting/Sales forecasting, Importance of forecasting, Application of purposes of sales forecasts.

Production planning: Definition, objectives of production planning, Factors influencing Process planning, Production control, principles and procedure of production control.

Self-study component:	Methods of sales forecasting.

UNIT – II	**Productivity**	**8 Hours**

Productivity: Definition, Productivity and production, Measurement of productivity, Productivity index, Importance of productivity, means of increasing productivity, Improving productivity by reducing work content, Relationship between productivity and standard of living, The benefits of increasing productivity**.**

Self-study component:	Productivity improvement procedure.

UNIT – III	**Plant location and Plant Layout**	**8 Hours**

Plant location: Introduction**,** Measuring the relative merits of single facility alternatives when the dominant factors are both tangible and intangible, single facility location decisions when the dominant factors are measurable costs.

Plant layout: Definition, types of plant layout problems, Factors affecting layout, steps in planning a plant layout.

Self-study component:	Objectives of plant layout.

UNIT – IV	**Applications of computers in Production Control and MIS**	**8 Hours**

Applications of computers in production control: Introduction, Application of computer in production control, Role, Computer control in production process.

Management information systems: Introduction, Definition, Characteristics, need for information, structure of a management information system.

Self-study component:	Research and problem solving.

UNIT – V	**Record Management**	**8 Hours**

Record Management: Definition, Qualities of a good report, steps in report preparation, Mechanizations, Objectives of mechanizations, Filling, Advantages of a good filling system, steps in instituting a filling system, steps in filling routine.

Self-study component:	Purposes of records management.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Describe** concept of Production planning control and the Factors influencing Process planning	Understanding	L2
CO2	**Define** concept of Productivity and Explain productivity improvement	Understanding	L2
CO3	**Summarize** plant layout and Plant location concept.	Understanding	L2
CO4	**Explain** the applications of computers in production control.	Understanding	L2
CO5	**Explain** the concept of Record Management and its Mechanizations.	Understanding	L2

Text Book(s):

1. "Industrial Engineering and Production Management" by Mahajan, Dhanpat Rai &CO private limited, educational & Technical publishers, 2nd edition, 2001.
2. "Production Planning Control and Industrial Management" by K.C.Jain, L.N.Aggrawal, Khanna publications, 1995.

Reference Book(s):

1. "Fundamentals of Production Planning and Control" by Stephen Chapman, 2007.
2. "Production planning and control" by R.Devaraj, L.Rasidhar, S.Ramachandran,Airwalk publications, 2017.

COMPUTER AIDED ANALYSIS LAB

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21IPL606**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**32**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Use Finite Element Analysis tools for solving simple structural problems to enhancing their analysis skills in the field of Computer Aided Engineering.

	Course Content	**32 Hours**

1. Introduction to ANSYS Application software
2. Application of line elements: bars of constant cross section area, tapered cross section area, stepped bars.
3. Application of line elements: Plane trusses, beams with point, uniform and variable loads.
4. Application 2-D elements: Beams, Plate with hole

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the applications of commercial FEA packages like ANSYS 2015.	Understanding	L2
CO2	**Solve** structural engineering problems using ANSYS	Applying	L3
CO3	**Validate** finite element results with analytical or experimental results.	Analyzing	L3
CO4	**Apply** the right finite elements techniques on various kind of machine parts	Applying	L3

Text Book(s):

1. Saeed Moaveni, "Finite Element Analysis Theory and Application with ANSYS", Pearson Education
2. ANSYS 15 Documentation.

Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21IPMP607**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

Employability Enhancement Skills (EES) - VI
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21HSMC608**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Explain the basic concepts in Race and games, Linear equations, mensuration, height and distance.
- Apply the logical skills in decoding Number, letter series and Game based assessments.
- Calculations involving Time, Speed and distance, HCF & LCM, Averages and Partnerships

UNIT – I	**10 Hours**

Quantitative Aptitude: Race and games, Linear equations

Logical Reasoning: Number and letter series

Self-Study: Types of cryptarithm.

UNIT – II	**10 Hours**

Quantitative Aptitude: Mensuration, Height & distance.

Logical Reasoning: Game based assessments.

Self-Study: Inferred meaning, Chain rule.

UNIT – III	**08 Hours**

Quantitative Aptitude: Time, Speed and distance, HCF & LCM, Averages and Partnerships

Self-Study: Decimal fractions

Course Outcomes: On completion of this course, students are able to:

CO – 1:	Solve the problems based on Race and games, Linear equations, mensuration, height and distance.
CO – 2:	Solve logical reasoning problems based on Number, letter series and Game based assessments.
CO – 3:	Solve the problems based on HCF & LCM, averages and partnerships.

Text Book(s):

1. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
2. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd
2. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
3. CAT Mathematics by Abhijith Guha, PHI learning private limited.

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - VI**]**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	2	2	-	-	-	-	-	-	-	-	-	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	2
CO-3	2	2	-	-	-	-	-	-	-	-	-	2

Universal Human Values and Professional Ethics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21UHV609**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25 + 5**	**SEE Marks:**	**50**

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions)

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

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous selfevolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module - 1

Introduction to Value Education **(3 hours)**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); • They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. • They would have better critical ability. • They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). • It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Expected to positively impact common graduate attributes like: 1. Ethical human conduct 2. Socially responsible behaviour 3. Holistic vision of life 4. Environmentally responsible work 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50

marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

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

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
- The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.

19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM