Course title: Work System Design			
Course code:	**22IP52**	Credits:	04
Teaching hours/week:	L:2 T:2 P:2	Total teaching hours:	**42**
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Basic Business and Management Concepts, Basic Ergonomics and Human Factors			

Course Objectives: The main objective of this course is

- To impart knowledge and skills in the theory and practice of systematic analysis of work methods, work measurement and work design,
- To improve productivity.
- To enable the students to be trained with planning of plant layouts and selection of site locations.

Modules	Teaching hours
Module I **Introduction to Industrial Engineering:** Definition, history of Industrial Engineering, objectives, place of Industrial engineering in an organisation. **Productivity**: Definition, reasons for low productivity, task of management. Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting productivity, measures to improve productivity. Total time of job, management techniques to reduce work content and ineffective time **Work Study**: Definition, objective and scope of work study, advantages and procedure of Work study. Human factors in work study, relationship of work study man with management, supervisor and workers.	**8**
Module II **Method Study** : Definition, objective, procedure, criteria for job selection, various recording techniques and their applications, like outline process chart, flow process chart, two handed process chart, multiple activity chart, SIMO chart, flow diagram, string diagram, cycle graph and chronocycle graph, critical examination, Therbligs, principles of motion economy, classification of movements, micro-motion study. Development and installation of new method. Examples on recording techniques.	**9**

Module III **Work measurements**: Definition, objectives and benefit of work measurement, work measurement techniques. **Stop Watch Time study**- definition, time study equipment, selection of job, steps in time study, breaking the job into elements, recording information, Rating, scales of rating, factors affecting rate of working, standard performance, allowances and standard time determination**.** **Work sampling**- need, confidence levels, sample size determination, random observation, conducting the study. **Predetermined motion time study**- Concept of PMTS, Method Time Measurement (MTM), Work factor system.	**9**
Module IV **Facility Location:** importance of location, factors affecting site location, rural vs urban location, factors in heavy manufacturing locations, light industry location, warehouse location, retail location. Quantitative and Qualitative analysis. Location break even analysis, P-Q chart, relationship chart (REL), introduction to systematic layout planning**,** introduction to layout, industrial buildings.	**8**
Module V **Plant Layout:** Definition of Plant Layout, Objectives of a good layout, and types of layout like product layout, process layout, fixed position layout, cellular layouts and hybrid layouts. Types of flow patterns. Basic features of manufacturing, advantages and disadvantages of Job, Batch, Line and Continuous production, types and assumptions, assembly line balancing-simple problems	**8**
Question paper pattern: **CIE:** Question paper will be for 40 consisting of four questions carrying 10 marks each. Students have to answer both the questions. **SEE:** There will be two questions from each module and students have to answer 5 questions selecting at least one question from each module. Each question will carry 20 marks and consist of a maximum of 3 sub-questions.	
Text books: 1. ILO- Introduction to Work study, 4th ed. 2. M. S. Sanders and Ernest J. McCormick- Human Factors Engineering and Design, McGraw Hill Inc 3. Barnes Ralph, Motion and Time Study, Design and Measurement of Work, Wiley 4. Suresh Dalela - Work Study and ergonomics, Standard Publishers Distributers 5. S.K.Sharma- Work Study And Ergonomics, S.K. Kataria& Sons	
Reference Books: 1. James Apple, "Plant layout and Material Handling", The Ronalt Press Co., New Delhi 2. Francis, McGinnis and White, "Facilities Layout and Location- an analytical approach", PHI 3. Thomas Thinandavha Munyai, Boysana LephoiMbonyane, Charles Mbohwa– Productivity Improvement in Manufacturing SMEs :Application of Work Study, CRC Press Online materials: https://nptel.ac.in/courses/112107142/	

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
22IP52	CO1	Describe the importance and usage of principles of Industrial Engineering and work study at various sectors in an organization and its effectiveness in improvement of productivity.
	CO2	List and Apply the various charts and diagrams to analyze the existing and develop improved methods of working.
	CO3	Understand the concept of rating and determine the time standards using appropriate techniques of work measurement
	CO4	Understand the locational principles and apply the concept of location selection, and evaluate different locations.
	CO5	Understand the various manufacturing and Apply plant layout principles to determine flow lines and design plant layouts.

Course title: Quality Assurance and Reliability Engineering			
Course code:	**22IP53**	Credits:	04
Teaching hours/week:	04	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Mathematics			

Course Objectives:

- This course introduces students
- To teach concepts and methods of modern statistical quality control.
- Students learn to apply standard quality control tools.
- They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations.
- They learn theory and methods for analyzing the performance of different quality control tools.

Modules	Teaching hours
Module I **Introduction:** Definition of quality, Quality function, Dimensions of quality, Quality Engineering terminology, Statistical methods of quality improvement, Quality costs – Four categories costs and hidden costs. Brief revision of Frequency distribution and Histogram. Probability distribution – Binomial, Poisson and Normal distribution. **Quality Assurance:** Definition and concept of quality assurance, Departmental assurance activities. Quality Audit concept, Structuring the audit program, Planning and performing audit activities, Audit reporting, Ingredients of a quality audit program	**8**
Module II **Statistical Process Control (SPC):** Introduction to Statistical Process Control – Chance and assignable causes of variation. Basic principles of control charts, Choice of control limits, Analysis of patterns of control charts. **Process Capability** – Basic definitions, Standardized formula, Relation to product tolerance and Six-sigma concept of process capability. **Control Charts for Variable:** Control charts for Mean and Range (R), Statistical basis of the charts, Development and use of X bar and R charts, Interpretation of charts. Control Charts for X-bar and standard deviation (σ), Development and use of X-bar and σcharts., X-bar and σ control charts with variable sample size.	**9**
Module III **Control Charts for Attributes:** Control charts for fraction non-conforming (defectives) – Development and Operation of control chart, Brief discussion on variable sample size. Control Charts for Non-conformities (defects) – Development and operation of control chart for constant sample size and variable sample size.	**9**

Choice between variable and attribute control charts. Guidelines for implementing control charts. **Sampling Plans and Operating characteristic curves** – construction and use. Acceptance plans – Single, Double and Multiple sampling. Determination of average outgoing quality, Average outgoing quality level, Average total inspection, Producer's risk and Consumer's risk. Construction of O.C Curve	
Module IV **Quality Circles:**Concept, structure, role of different members, tools used and case studies. **ISO Quality Systems:** ISO/QS9000 Quality Systems – History of ISO 9000 Standards, QS 9000 quality standards, Goals and their standards.	**8**
Module V **Introduction to Reliability Engineering** **Reliability:** Definition, Mean failure rate, Mean time to failure, Mean time between failure, hazard rate, hazard models. Constant hazard, linearly increasing hazard, Weibull model. System reliability, series, parallel and mixed configuration - simple problems, Life testing – Objective, classifications. **Reliability Improvement:** Reliability improvement redundancy, element, unit and stand by redundancy, reliability allocation for a series system. Maintainability and availability	**8**

Question paper pattern:
CIE: Question paper will be for 40 consisting of four questions carrying 10 marks each. Students have to answer both the questions.
SEE: There will be two questions from each module and students have to answer 5 questions selecting at least one question from each module. Each question will carry 20 marks and consist of a maximum of 3 sub-questions.

Text books:

1. D.C. Montgomery, "Introduction to Statistical Quality Control", 3rd edition, John Wiley and Sons.
2. J.M. Juran and Frank M. Gryna, "Quality Planning and Analysis", 3rd edition, Tata McGraw Hill.
3. L S Srinath-"Engineering Reliability",

Reference Books:

1. Grant and Leavenworth, "Statistical Quality Control", McGraw Hill.
2. Janet L. Novack and Kathleen C. Bosheers, "The QS9000 Documentation Toolkit", Prentice Hall PTR.
3. Suresh Dalela and Saurabh, "ISO 9000 A Manual for Total Quality Management", S.Chand and Co. Ltd., Ram Nagar, New Delhi.
4. Tapan P. Bagchi, "ISO 9000 Concepts, Methods and Implementation", Wheeler Publishing. A Division of AH Wheeler & Co. Ltd., New Delhi.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
22IP53	CO1	Students will gain the knowledge of quality concepts and basics of statistics.
	CO2	Prepare graphical presentation using quality control techniques
	CO3	Analyse control charts and sampling plans
	CO4	Analyse quality circles and ISO quality systems in process control
	CO5	Analyse reliability of the systems

Course title: Quality Assurance Lab			
Course code:	**22IPL54**	Credits:	01
Teaching hours/week:	-	Total teaching hours:	-
Practical ours/week	02	Total practical hours	28
CIE: 50 marks	SEE: 50 marks	SEE: 3 hours	

Course Objectives:
The objective of this course is to provide students with skills in systematic understanding of Quality Assurance Techniques

Course contents	Practical Hours
1.To test the Goodness of fit for the given quality characteristic using Binomial distribution	**4**
2.To test the Goodness of fit for the given quality characteristic using Poisson distribution	**4**
3.To test the Goodness of fit for the given quality characteristic using Normal distribution	**4**
4.Construction of control chart for attribute quality characteristic	**4**
5.Construction of control chart for variable quality characteristic	**4**
6. Application of Acceptance Sampling Techniques (Single sampling plan and OC Curve) Using Deming's Red Bead Experiment	**4**
7. Exercises on FMEA	**4**

Question paper pattern: Students have to answer two questions. One question is set for 20 marks and another question is set for 30 marks

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
22IPL54	CO1	Understanding of Binomial Distribution
	CO2	Understanding of Poisson distribution
	CO3	Understanding of Normal distribution
	CO4	Understanding Control Chart and sampling Techniques
	CO5	FMEA

Course title: Industry 4.0			
Course code:	**22IP554**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE : 3 hours	

Prerequisite:

- Manufacturing, Automation, CAD/CAM, CIM, VR, EIT and AI

Course Objectives:

- Incorporate the advances in the field of industries.
- Learn Cyber Physical System
- Knowledge gaining of human Robot collaboration
- Adopt AI
- Gain safety and security of environment in organisation

Modules	Teaching hours
Module I **1: Introduction to Industry 4.0:** Definition of Industry 4.0, What is it all about and why do we have to change industrial production, Comparison of Industry 4.0 Factory and today's Factory, the 10 most important things that will change with Industry 4.0, Difference between conventional automation and Industry 4.0. Basic principles and technologies of a Smart Factory: Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber-Physical Systems, Value chains in manufacturing companies, Customization of products, Digital Twins, Cloud Computing / Cloud Manufacturing.	**08**
Module II **2. Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS)**: What are cyber-physical systems?, Definition: Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory and real-time requirements, Communication in cyber-physical systems, Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development), Applications for cyber-physical systems (examples of existing or future applications in the field of manufacturing, traffic, medical technology, etc.)	**09**
Module III **3.Assistance systems for production:** The connected worker within the Industry 4.0 scenario, Diversity-driven workplaces (barrier free workplaces, accessibility in production), Human-and task-centred assistance systems (e.g. motion capture system for training employees, etc.), Technical tools ("Ambient Assisted Working" (AAW)), Mobile information technologies, Shop floor information systems, Production line support systems (pick by light, assembly display systems, assembly control by vision, …), Applications assistance systems in production (examples of existing or future applications in the field of manufacturing) **The six main use-cases for Augmented Reality in Manufacturing:** AR-devices an Overview (different versions, Videos) • Use case 1: Integrating Design and	**09**

Manufacturing • Use case 2: Training Shop floor Workers • Use case 3: Supporting complex Assembly Operations • Use case 4: Service and Maintenance • Use case 5: Supporting complex Sales solutions • Use case 6: Executive Oversight and Data Visualisation • Applications with Augmented Reality (examples of existing or future applications in the field of manufacturing)	
Module IV **4. Human-Robot Collaboration:** Human-Robot Collaboration in Industry, Collaborative Robots, tasks, examples (Yumi, IIWA, UR, Panda, …), Types of Human-Robot Collaboration, Applications with Collaborative Robots (examples of existing or future applications in the field of manufacturing). **Interoperability:** Communication systems and standards for Industry 4.0, The Industry 4.0 Reference Architecture Mo4del RAMI4.0, Basics on Service oriented Architecture, OPC-UA as future standard in Industry 4.0, Machine to machine interaction in practice (examples of existing or future applications in the field of manufacturing) **Cloud Manufacturing and the connected factory:** Virtualization, Cloud Platforms, Big data in production, Cloud-based ERP and MES solutions, Connected factory applications, Predictive Maintenance Data Visualisation, Using a Cloud Development Environment to develop a Predictive Maintenance Tool for Manufacturing. Cloud Development in practice (examples of existing or future applications in the field of manufacturing.	**08**
Module V **5. Artificial Intelligence in Production:** Machine Learning Application, Basics of Machine Learning, The Machine Learning Process, Machine Learning in practice (examples of existing or future applications in the field of manufacturing); **Safety and Security in networked Production Environments:** What means Safety with Industry 4.0, Safety for connected Machines and Systems, Safety in Human Robot cooperation, How Industry 4.0 can optimise Safety, Security & Security Risks with Industry 4.0, Security and privacy risks in AI, Approach to Cyber-Physical Security in Industry 4.0.	**08**

Question paper pattern:
CIE: Question paper will be for 40 consisting of four questions carrying 10 marks each. Students have to answer both the questions.
SEE: There will be two questions from each module and students have to answer 5 questions selecting at least one question from each module. Each question will carry 20 marks and consist of a maximum of 3 sub-questions.

Text books:

- Industry 4.0 Current Status and Future Trends Edited by Jesús Hamilton Ortiz

Reference Books:

- Industry 4.0Concepts, Processes and Systems Edited By Ravi Kant, Hema Gurung

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome (CO)
	CO1	Have learnt Industry 4.o

22IP554	**CO2**	Learnt CPS
	CO3	Human Robot Collaboration
	CO4	Knowledge of AI
	CO5	Cyber Security

Course title: Mini Project			
Course code:	**22IPMP56**	Credits:	2
Teaching hours/week:	-	Total teaching hours:	-
Practical ours/week	04	Total practical hours	28
CIE: 50 marks	SEE: 50 marks	SEE: 3 hours	

Course Objectives:

The objective of the course is to

- Apply the knowledge of Industrial and production engineering.
- Expose the students to industrial environment
- Develop analytical ability of the students.

Course contents	**Practical Hours**
Each candidate must complete the prescribed number of days of practical training to the satisfaction of the concerned department. This training will be arranged in the summer vacation following the 6th semester. Training should be carried out preferably in industry or R&D institutions in India. One faculty will act as coordinator for practical training. Training in academic institutions is discouraged. The department will appoint a training supervisor for each student. The supervisor is expected to keep contact with the assigned students through e-mail and /or telephone. The students will be required to get their training plan reviewed by their supervisor within the first week and report their progress on weekly basis. Supervisor, if desires, may visit the organization. Visits within the country will be supported by the institute.	**28**

Question paper pattern:

1. Write up with necessary programs = 15 Marks
2. Execution = 25 Marks
3. Oral = 10 Marks
Total = 50 Marks

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	**CO #**	**Course Outcome (CO)**
22IPMP56	CO1	Demonstrate the skill to form and work in group to perform the selected task.
	CO2	Execute the selected task as per the schedule
		Apply or upgrade the technical skills.

	CO3	
	CO4	Execute the skill to choose better option among technical alternatives
	CO5	Communicate technical information to others effectively by means of formal presentations, drawings and reports.

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS			
Course Code	22RMI57	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	2:2:0	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To understand the knowledge on basics of research and its types.
- To learn the concept of defining research problem and Literature Review, Technical Reading.
- To learn the concept of attributions and citation and research design.
- Concepts, classification, need for protection, International regime of IPRs -WIPO,TRIPS, Patent - Meaning, Types, surrender, revocation, restoration, Infringement, Procedure for obtaining Patent and Patent Agents.
- Meaning, essential requirements, procedure for registration and Infringement of Industrial Designs, Copyright.

Modules	Teaching Hours
Module-1	
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship	**6**
Module-2	
Defining the research problem - Selecting the problem. Necessity of defining the problem Techniques involved in defining the problem- Importance of literature review in defining a problem Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.	**6**
Module-3	
Research design and methods - Research design - Basic principles. Need of research design Features of good design- Important concepts relating to research design – Observation and Facts Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	**6**
Module-4	

Basic Concepts of Intellectual Property (IP), Classification of IP, Need for Protection of IP, International regime of IPRs - WIPO , TRIPS. Patents: Meaning of a Patent – Characteristics/ Features. Patentable and Non-Patentable Invention. Procedure for obtaining Patent. Surrender of Patent, revocation &restoration of Patents, Infringement of Patents and related remedies (penalties). Different prescribed forms used in Patent Act. Patent agents qualifications and disqualifications Case studies on patents - Case study of Neem petent, Curcuma(Turmeric)patent and Basmati rice patent, Apple inc. v Samsung electronics co.Ltd	**5**
Module-5	
Industrial Design: Introduction to Industrial Designs. Essential requirements of Registration. Designs which are not registrable, who is entitled to seek Registration, Procedure for Registration of Designs Copy Right Meaning of Copy Right. Characteristics of Copyright. Who is Author, various rights of owner of Copyright. Procedure for registration. Term of copyright, Infringement of Copyright and Its remedies. Software Copyright.	**5**

Question paper pattern:

- The question paper shall have five Module for100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each odule.

Note: There can be a maximum of 4 sub sections in each Question.

TextBooks:

1. Research Methodology: Methods and Techniques C.R.Kothari, GauravGarg New Age International 4th Edition,2018
2. Dipankar Deb•RajeebDey,Valentina E.Balas "Engineering Research Methodology",ISSN1868- 4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.3
3. Dr. M.K. Bhandari"Law relating to Intellectual property" January 2017 (Publisher By Central Law Publications). Dr. R Radha Krishna and Dr. S Balasubramanain "Text book of Intellectual Property Right". First edition, New Delhi 2008. Excel books.
4. P Narayan"TextbookofIntellectualPropertyRight".2017,Publisher: EasternLaw House

ReferenceBooks:

1. DavidV.Thiel "Research Methods for Engineers"CambridgeUniversityPress,978-1-107-03488-4-
2. Nishith Desai Associates-Intellectual property law in India– Legal, Regulatory &Tax

Ebooksandonlinecoursematerials:

- NPTEL: INTELLECTUAL PROPERTY by PROF.FEROZALI, Department of Humanities and Social Sciences IIT Madras https://nptel.ac.in/content/syllabus_pdf/109106137.pdf
- www.wipo.int
- www.ipindia.nic.in

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
	CO1	To know the meaning of engineering research.

22RMI57	**CO2**	To know the defining of research problem and procedure of Literature Review.
	CO3	To know the Attributions and Citations and research design.
	CO4	Highlights the basic Concepts and types of IPRs and Patents
	CO5	Analyze and verify the procedure for Registration of Industrial Designs & Copyrights

ENVIRONMENTAL STUDIES			
Subject Code	**22ES58**	Credits:01	CIE:50
Number of Lecture Hours/Week	2 hrs		SEE:50
Total Number of Lecture Hours	28 hrs		SEE Hours:01
Prerequisite: Nil			

Course Objectives:

To creative environmental awareness among the students'
To gain knowledge on different types of pollution in the Environment.
Teaching- Learning process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos and animation films may be adopted so that the delivered lesson can progress the students in theoretical applied and practical skills.
2. Environmental awareness program on off campus
3. Encourage Collaborative (Group learning) learning in the class seminars, surf prize test and quizzes may be arranged for students in respective subjects to develop skills

Modules	Teaching Hours
Module:1 Environment-Definition, components, Ecosystem-Balanced Ecosystem, Structural and functional unit of Ecosystem, Human activities – Economic and Social Security	**5 Hours**
Module:2 Human activities Effects on Environment-Industries, Housing, Agriculture, mining, Transportation, Natural Resources-Water Resources, forest, mineral resources, fluoride problems in Drinking water, water Induced diseases. Deforestation, sustainable mining,	**6 Hours**
Module:3 Material cycles – Nitrogen, Sulphur, carbon cycle Environmental pollution –ground water pollution, noise pollution, soil pollution, Industrial and Municipal sludge. Air pollution, B.O medical waste E-wastes, Automobile pollution	**6 Hours**
Module:4 Global Environmental Concerns-Climate change and global warming effects, urbanization, ozone layer depletion, acid rain, current Environmental issues and important, population growth, Environmental toxicology, Biogas energy, solar energy.	**6 Hours**

Module:5 Objects of Environmental studies, Importance of women's Education, non-government organization (NGO), Green building or water treatment plant, G.I.S and Remote sensing, EIA (Environmental Impact Assessment), Role of Government for protection of Environmental	**5 Hours**
References Textbooks: - 1. Environmental Studies- Benny Joseph –Tata Megrawhill 2005 2. Environmental Studies-D L Manjunath, P M Dotrad, B.S.Raman 3. Environmental Studies-Geeta Naagbhushan	

At the end of the course students will be able to :

CO	Course Outcomes
CO1	Understand the Environmental components balance eco systems
CO2	Develop critical thinking and apply them to the analysis of a problems or question related to Environment
CO3	Demonstrate Ecology knowledge of a complex relationship between biotic and a biotic components
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers phase when dealing with complex issue
CO5	Understand latest developments in environmental pollution, Mitigation, Tools Concept and applications of G.I.S and Remote sensing.

Course title: Engineering Economics			
Course code:	22IP551	Credits:	03
Teaching hours/week:	3	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: -			

Course Objectives:

The objective of this course is to give the working engineer an overview of the economics methods employed in effective engineering decisions.

Modules	**Teaching hours**
Module I Introduction to Engineering Economics, Engineering and Economics, Engineering decision, Engineers as decision makers, Problem solving and decision making, Decision maze, Intuition and analysis, Tactics and strategy. Demand and supply, law of demand, elasticity of demand, factors governing elasticity of demand, law of returns, law of diminishing returns**.**	**8**
Module II Interest rate, simple and compound interest, Nominal and effective rate of interest, cash flow diagram, Compound interest factors- single payment compound amount factor, single payment present worth factor, Uniform series sinking fund factor and uniform series compound amount factor, Uniform series capital recovery factor and uniform series present worth factor, Arithmetic gradient conversion factor for uniform series.	**7**
Module III Introduction , conditions for present worth comparison, Rule of 72, basic problems on PW comparison, PW comparison of assets with unequal lives, Future worth comparison, Pay back comparison	**7**
Module IV Introduction & situations for Equivalent annual worth comparison, Assets with equal lives, Assets with unequal lives, Use of sinking fund method, annuity contract for guaranteed income**.** Introduction to concept of ROR, IRR &MARR, Cost of capital concept, comparison of alternatives using IRR.	**11**
Module V Definition, causes and importance of depreciation, Methods of computing depreciation.Causes, consequences and control of inflation in India, Tax concepts, lease or buy decisions	**9**

Question paper pattern:

CIE: Question paper will be for 20 consisting of two questions carrying 10 marks each. Students have to answer both the questions.

SEE: There will be two questions from each module and students have to answer 5 questions selecting at least one question from each module. Each question will carry 20 marks and consist of a maximum of 3 sub-questions.

Text books:

1. "Engineering Economics", Paneerselvam, PHI Publishers
2. "Engineering Economics", James Riggs, Mcgraw Hill Publications

3. "Engineering Economics", R.K. Hegde,

Reference Books:

1. "Engineering Economy", Paul DeGarmo
2. "Engineering Economics", Thuesen H

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
16IP55	CO1	Understand the need of economics for engineers and the process of decision making
	CO2	Understand the laws associated with demand and supply in order to calculate demand and price elasticity of demand
	CO3	Understand the interest factors and time value of money and apply it to value streams of cash flow
	CO4	Understand the need for economic analysis of alternatives and be able to compare alternatives based on various criteria
	CO5	Be competent to compute the book value by applying various methods of depreciation calculation and understand the effects of inflation and taxation

Course title: Human Resources Management			
Course code:	**22IP552**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

Course Objectives:

- To develop the knowledge, skills and concepts needed to resolve actual human resource management problems or issues.
- To identify the human resources needs of an organization or department.
- To Conduct a job analysis and produce a job description from the job analysis.
- To analyze various recruitment / selection strategies, training methods and performance evaluation approaches in order to identify which is better applicable for a given organization
- To provide understanding of the framework within which an organization operates and how it affect the management of people
- To distinguish how an organization establishes reward, motivational and developmental schemes
- To provide a clear underrating of features and issues related to international HRM

Modules	Teaching hours
Module I Introduction: Evolution of HRM, Objectives, Functions and Policies. Human Resource Planning process, job analysis job description and job specification Recruitment and Selection: Sources of Man power, Advertisement Selection procedure Components of Selection procedure : application form, Written Tests, Group Discussions, Interview – Different methods, procedure guidelines, Graphology	**7**
Module II Training and Development: Identification of Training needs, objectives Different methods Training Evaluation, Executive Development Training as a tool for continuous growth of Individual and Organizers.	**9**
Module III Induction procedure, transfers, promotion, exit interview. Motivation: Motivation, The hierarchy of need theory, Theory X and theory Y, Two factors theory-Hygiene and Motivator factors, Financial and Non-financial Motivators Communication: communication function its significance, barriers in communication process, effective communication	**9**
Module IV	**9**

International HRM: Managing across borders, International staffing, Skills of a global manager, Non verbal communication, Dual career couples, Mentoring Industrial Disputes and Settlement: Industrial disputes, Indian Industrial Disputes act, Settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Industrial tribunal, Adjudication	
Module V Performance Appraisal: Meaning, need, purpose and contents of performance appraisal, Methods – traditional and modern methods, Advantages and limitations of different methods, Personal Counselling based on Annual Confidential Reports. Case Studies : on Staffing, Training, Performance evaluation Motivation and Industrial disputes (At least Two)	**8**

Question paper pattern:
CIE: Question paper will be for 20 consisting of two questions carrying 10 marks each. Students have to answer both the questions.
SEE: There will be two questions from each module and students have to answer 5 questions selecting at least one question from each module. Each question will carry 20 marks and consist of a maximum of 3 sub-questions.

Text books:

1. Dr. K Ashwathappa-Human Resources Management, Tata McGraw Hill, 4th Edition, 2005.
2. P Subba Rao- Human Resources Management and Industrial Relations Himalaya publishing house
3. Hersey and Blanchard -Management of Organizations Behaviour, Prentice Hall of India, 10th Edition – 2012.
1. Arun Monappa -Industrial Relations, TMH, ISBN – 0-07-451710-8, 2007

Reference Books:

1. Decenoz and Robbins -Personnel / Human resource Management, PHI, 2002.
2. C.B Mamoria -Management of Human Resources, Himalaya Publication House, 2003.
3. Jain -Industrial Acts, TMH Publications, 2004.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Execute the basic human resource functions, perform HRP and understand difference between domestic and international HRM
	CO2	Develop the right type of recruitment and selection strategy for a given organization

22IP552	**CO3**	Design and develop the appropriate training program for the employees of an organization after analyzing the training needs
	CO4	Apply the basics of creating healthy working environment and work culture in which employee contribute with their full potential
	CO5	Measure and monitor people's performance in an organization
	CO6	exploit the possibilities employing leadership qualities and also effective communication in managing human resource in an organization

Fundamentals of Robotics and Applications		Semester	III
Course Code	22IP555	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours	42	Total Marks	100
Credits	03	Exam Hours	03
Examination nature (SEE)	Theory		

COURSE OVERVIEW:

Robotics is an interdisciplinary branch of electronic engineering and mechanical engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design machines thatcan help and assist humans. Robotics integrates fields of mechanical engineering, electrical engineering, information engineering, Mechatronics, electronics, bioengineering, computer engineering, control engineering, software engineering, mathematics, etc.

Course Objectives:

The objectives of this course are to:

1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots.
3. Explain intelligent module for robotic motion control.
4. Educate on various path planning techniques.
4. Illustrate the working of innovative robotic devices

Teaching-Learning Process (General Instructions)

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

1. The lecturer's approach (L) does not have to be limited to traditional methods of teaching. It is possible to incorporate alternative and effective teaching methods to achieve the desired outcomes.
2. Utilize videos and animations to illustrate the functioning of different techniques used in the manufacturing of smart materials.
3. Foster collaborative learning exercises within the classroom to encourage group participation and engagement.
4. Pose a minimum of three Higher Order Thinking (HOT) questions during class discussions to stimulate critical thinking among students.
5. Implement Problem-Based Learning (PBL) as an approach that enhances students' analytical skills and nurtures their ability to design, evaluate, generalize, and analyze information, rather than solely relying on rote memorization.

Module-1

Introduction To Robotics: Introduction to Robotics and Automation, laws of robot, brief history ofrobotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and thefuture prospects, advantages and disadvantages of robots. **8 Hours**

Module-2

Robot Anatomy And Motion Analysis: Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

8 Hours

Module-3

Robot Drives And End Effectors: Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

8 Hours

Module-4

Path Planning: Definition-Joint space technique, Use of P-degree polynomial-Cubic,polynomial-Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.

8 Hours

Module-5

Robotics Applications: Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots

8 Hours

Course Outcomes (COs) (Course Skill Set)

At the end of the course, the student will be able to :

CO1: Understand the significance, social impact and future prospects of robotics and automationin various engineering applications.

CO2: Identify and describe the components and anatomy of robotic system.

CO3: Know about various path planning techniques and analyze different motions of roboticssystem

CO4: Use the suitable drives and end-effectors for a given robotics application.

CO5: Apply robotics concept to automate the monotonous and hazardous tasks and categorize varioustypes of robots based on the design and applications in real world scenarios.

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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student securesa 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 Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal AssessmentTest component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based thenonly one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy asper the outcome defined for the course.

Semester-End Examination (SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common questionpapers

for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
3. Ganesh S Hegde, "A textbook on Industrial Robotics", University science press, 3rdedition,2017.

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGrawHill, 1987. https://www.robots.com/applications.

Web links and Video Lectures (e-Resources):

1. https://roboticscasual.com/ros-tutorial-pick-and-place-task-with-the-moveit-c-interface/
2. https://roboticscasual.com/ros-tutorial-simulate-ur5-robot-in-gazebo-urdf-explained/
3. https://roboticscasual.com/the-best-degrees-to-work-in-robotics/
4. https://roboticscasual.com/robotics-tutorials/
5. https://www.ieee-ras.org/educational-resources-outreach/educational-material-in-robotics-and-automation
6. https://www.academia.edu/20361073/Web_Based_Control_and_Robotics_Education_pdf
7. https://github.com/Developer-Y/cs-video-courses
8. https://www.isa.org/
9. https://www.asme.org/engineering-topics/articles/bioengineering/top-6robotic- applications-in-medicine.