

Course title: Human Factors and Ergonomics			
Course code:	22IP61	Credits:	04
Teaching hours/week:	L:3 T:2 P:0	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Industrial Engineering Basics, Design and Usability, Occupational Health and Safety			
Course Objectives: To study, understand and apply the basic parameters of Human factors engineering/ Ergonomics in the design of work systems that helps in improving the efficiency and effectiveness.			
Modules			Teaching hours
<p align="center">Module I</p> <p>Introduction: Introduction to Human factors Engineering/Ergonomics: Scope and objectives, Definition & historical evolution, Basic principles, System approach to ergonomics, Significance of ergonomics, Components of man-machine systems</p> <p>Displays and controls: Displays: Classification of displays, quantitative and qualitative displays, alphanumeric displays, multiple displays, colour, resolution, auditory displays, display layouts, Controls: types, design criteria of controls, Relationship between displays and controls.</p>			8
<p align="center">Module II</p> <p>Anthropometry Static and dynamic anthropometry, Ergonomics and design, user-centred approach, statistical description of human variability, Anthropometric data: measurements, percentiles, use of anthropometric data in design, adjust-ability requirements, visibility and normal line of sight. Work space design-clearance, reach, working heights, design for standing and seated work, an ergonomic approach to work station design.</p>			9
<p align="center">Module III</p> <p>Biomechanics of work: Musculoskeletal system & work related musculoskeletal disorders: causes and prevention, Lower back pain, awkward postures, and risk associated with it. RULA/REBA/Strain index/OWAS methods for risk assessment in occupational tasks. Manual material Handling: NIOSH lifting equation.</p>			10
<p align="center">Module IV</p> <p>Environmental conditions- Illumination: nature of light, visibility, effects of lighting on performance, measurement of light.</p>			7

Noise: noise and effects of noise on performance, noise exposure limits, measuring noise levels, control of noise Hot and cold environments: occupational heat stress exposure, assessment at workplace, permissible limits		
Module V		
Work Physiology: Physical work, measures of physiological work load and energy consumption, measurement of heart rate, BP, cardiovascular health, lung capacity, Spirometry, Strength and endurance-measurement of hand grip force, pinch force and arm, body mass index, introduction to cognitive ergonomics.		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. Mark S. Sanders and Ernest J Mc McCormick; Human Factors in Engineering and Design; McGraw-Hill and Co. Singapore, 7th Ed. 1992 2. R S Bridger, Introduction to Ergonomics, Taylor & Francis, 2nd Ed. 2003, 3. Suresh Dalela- Work Study and Ergonomics 4. M.I.Khan- Industrial Ergonomics- PHI 5. L.P.Singh- Work Study and Ergonomics- Cambridge press		
Reference Books: 1. Gavriel Salvendy-Editor, Handbook of Human Factors and Ergonomics, Wiley 2. Stephen Pheasant – Body Space -Anthropometry, Ergonomics and the Design of Work, Third Edition 3rd Edition, CRC Press 3. Stephen J. Guastello - Human Factors Engineering and Ergonomics: A Systems Approach, Second Edition 2nd Edition Online link: https://nptel.ac.in/courses/107103004/31		
Course outcomes: On completion of the course, the student will have the ability to:		
Course Code	CO #	Course Outcome (CO)
22IP61	CO1	Identify the role of ergonomics and its application in occupational tasks.
	CO2	Identify the importance of Anthropometry and Apply Ergonomic concepts in the existing systems and design of new systems.
	CO3	Apply the various ergonomics assessment tools to identify the risk factors in the work systems.
	CO4	Assess the effect of environmental factors like Heat stress, noise, illumination, vibration, dust and fumes on human performance.
	CO5	Understand the "physiology" of human body and types of movements causing ergonomic problems related to tools, task and workplace

Course title: Operations Research			
Course code:	22IP62	Credits:	04
Teaching hours/week:	L:3 T:2 P:0	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Mathematics, Basic Computer Science			
<p>Course Objectives:</p> <p>OR students will be well grounded in the mathematical, engineering, and modelling skills that are the basis for operations research, and they will be prepared to apply those skills to the efficient design, analysis, operation and control of complex systems.</p> <p>Their OR academic program will include:</p> <ol style="list-style-type: none"> 1. One or more advanced courses on applications in: supply chain and manufacturing systems; data analysis; information engineering; financial engineering; or service systems. 2. A collaborative systems design experience. 3. Collaborative project experiences involving both written and oral presentations. 4. Courses with significant experiential learning components. 5. Experiences with identifying, accessing, evaluating, and interpreting information and data in support of assignments, projects, or research. 6. Course experiences with large-scale data sets 			
Modules			Teaching hours
<p align="center">Module I</p> <p>Introduction to OR : Definitions, Phases of OR study and applications Linear Programming problems: Mathematical Formulation, Standard Form, basic Solutions, Feasible Solutions, Optimal Solutions, Degenerate solutions, Graphical and Simplex methods. Two Phase and Big-M methods, Unbounded, In feasible and alternative solutions. Resolving Degeneracy in LPP, Revised simplex methods sensitivity analysis.</p>			10
<p align="center">Module II</p> <p>Assignment problem: Formulation, Hungarian Method, Unbalanced problem, Assignment for maximization, Travelling Salesman problem</p> <p>Transportation Problem: Formulation of Transportation Model, Basic Feasible solution by NWC Rule, Row Minimum, Lowest cost entry and Vogel approximation methods. Optimality methods, Unbalanced problem, degeneracy in transportation.</p>			9
<p align="center">Module III</p> <p>Project management : Network Construction, CPM: determination of critical path and Total elapsed time, Concept of slack and Float, PERT- Estimation of Project duration and Variance, analysis about the completion of projects.</p> <p>Crashing of Networks: Basic concept, Optimal cost of the project</p>			8

Module IV		
Games Theory : Formulation of Games, Characteristics of games, Two-Person Zero Sum game, Maximin/Minimax principle, Saddle point, games without saddle point, solution for (2 X 2) game, dominance property, Graphical solution for (2 x n) and (n x 2) games		7
Module V		
Queuing Theory: Queuing system : Types and Characteristics, Steady state analysis of M/M/1 and concept of M/M/K model Replacement problem: Basic Concept of Replacement of items that deteriorate with time: costs involved, Replacement procedure with and without consideration of Time value of money. Replacement of items that fail suddenly: Group Replacement		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.		
Reference Books: 01. Taha S A –“Opeartions Research and Introduction”, McMillian 02. Philips, Ravindran and Soeberg- “Principles of Operations research”, PHI 03. Hiller and Liberman-“ Introduction to Operations Research”, McGraw Hill V Edn 04. S.D.Sharma –“Opeartions Research”, Kedarnath, Ramnath and Co.		
Course outcomes: On completion of the course, the student will have the ability to:		
Course Code	CO #	Course Outcome (CO)
22IP62	CO1	Develop proficiency with tools for optimization and their application in industry Involving scarce resources
	CO2	Apply the concept of assignment and transportation problem to formulate and solve decision making problem
	CO3	utilize the network techniques to manage the scarce resources and optimize for a given project
	CO4	Apply the concept of queuing and games theory and solve for optimization
	CO5	Perform economic analysis for replacement problem

Course title: Supply Chain Management			
Course code:	22IP631	Credits:	03
Teaching hours/week:	L:3 T:0 P:0	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Basic Business and Economics, Mathematics and Statistics			
Course Objectives:			
To expose students to latest techno managerial theory for understanding the basics and advanced managerial efforts to be put in real industries across the globe with a vision to enhance the quality of customer without compromising for the price.			
Modules			Teaching hours
Module I Introduction: Definition and objectives of supply chain, decision phases in supply chain, process overview of supply chain, importance of supply chain. Supply Chain Performance: Achieving Strategic fit, drivers of supply chain performance, frame work for structuring drivers- facilities, inventory, transportation and information.			9
Module II Obstacles for achieving strategic fit, Designing supply chain network: Role of distribution in supply chain, factors influencing design of distribution network, design options for distribution network, value of distributors in supply chain.			8
Module III Network design in Uncertain Environment. Impact of Uncertainty DCF analysis, evaluating network design decisions using decision trees. Supply Economies of Scale in Chain: Role of inventory in supply chain, economies of scale to exploit fixed costs and quantity discounts, managing multi echelon cycle inventory.			9
Module IV Transportation: Factors affecting transportation decision, Modes of transportation and their characteristics, designing transportation networks, trade-off in transportation design international transportation. Revenue Management: Multiple customer segments.			8
Module V Perishable assets, seasonal demand & bulk and spot customers. Coordination and IT in Supply Chain: Bullwhip effect, obstacles to coordination, managerial levers to coordination, role of IT in Supply Chain, Supply Chain IT framework, e-business.			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.

Reference Books:

1. Sunil Chopra & Peter Meindl - "Supply chain Management" Pearson education
2. Martin Christopher - "Introduction to Supply Chain Management"
3. B.S.Sahay " Supply Chain Management" Mcmillan

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
22IP631	CO1	<i>Explain supply chain management, supply chain performance.</i>
	CO2	Apply sc strategic fit and designing aspects of sc network distribution
	CO3	Analyze uncertain environment in sc and economies of scale
	CO4	Explain transportation aspects and revenue management
	CO5	Explain types of assets and coordination in SCM, IT & e commerce

Course title: HUMAN FACTORS ENGINEERING			
Course code:	22IPOE641	Credits:	03
Teaching hours/week:	L: 3 T: 0 P: 0	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: Basic Psychology, Basic Anatomy and Physiology, Basic Engineering Principles			
<p>Course Objectives: The main objective of this course is to provide basic understanding to the students about the concept and significance of Human Factors Engineering, through imparting knowledge about visual, auditory and cognitive aspects of human factors. To inculcate the skill among the students for analysing human systems integration and improving overall decision making and the performance of the system. To inculcate analyzing skills among the students with respect to work place design, working postures and lifting tasks. To provide thorough knowledge about assessment about occupational exposure to heat stress, noise, vibrations and RSPM.</p>			
Modules			Teaching hours
<p align="center">Module I</p> <p>Introduction to Human Factors and Ergonomics, History of development, Aims and Objectives, Areas of application of ergonomics, benefits, disciplines and their inter-relationships, principles of ergonomics, Human factors significance in design work place. Man-Machine Systems- characteristics of man-machine systems, types, basic concepts of work systems, work organization, evaluation of interfaces/interaction in workplace, work system performance and interaction design, Role of Human Factors Engineering in today's Industrial Context, Human Centric Design.</p> <p>Displays and Controls- Displays, Qualitative and Quantitative, design principles, types, visual, auditory, Design of Controls-criteria for design, types of controls, relationship between displays and controls.</p>			8
<p align="center">Module II</p> <p>Anthropometry- Introduction, Significance of Anthropometry in Human Factors, Human Variability, Use of Anthropometric Data, Measurements- Static and Dynamic, Tools for measurements, Percentiles, design principles, Body Mass Index.</p> <p>Workstation Design- choice of work stations, seated, standing, sit-stand, design guidelines for work station, work space envelope, anthropometry in work station design, examples- computer workstation, assembly workstation, seat designing etc</p>			9

<p style="text-align: center;">Module III</p> <p>Musculoskeletal Disorders- what are MSDs, Causes, types, ergonomic risk factors, prevention, early intervention. Work-related MSDs, musculoskeletal systems, risk factors, symptoms, examples of WRMSDs, carpal tunnel syndrome, Tennis Elbow, MSD surveys Questionnaire, Nordic Musculoskeletal Discomfort Questionnaire.</p> <p>Physical Loading-Posture, Force and Time, examples of awkward/neutral postures, measuring postures, Ergonomic Assessment Techniques – Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), and NIOSH Lifting Equation for Single Tasks (NIOSH).</p>	9
<p style="text-align: center;">Module IV</p> <p>Work Environmental Factors- The human body in different environments, Industrial Hygiene, Thermal Climate, Thermal Exposure Risks, Heat, Cold, Heat stress, Lighting, Illuminance, Measuring light parameters, Glare, effects of lighting on performance, Sound and Noise, Examples of noise levels, Effects of noise, measuring noise, Noise Control, Hearing protection, Vibrations- Hand arm vibration and Whole-body vibration, Respirable Suspended Particulate Matter (RSPM), Dust and Fumes, Personnel Protective Equipments</p>	7
<p style="text-align: center;">Module V</p> <p>Cognitive Ergonomics-Cognitive ergonomics, what cognitive limitations exist in the workplace? Human error, Human capabilities and limitations, Application of Cognitive Ergonomics, The senses, Vision, Hearing, Touch, Human cognitive processes-Attention, Learning and Memory, Categorization of memory, Perception, Mental models, Sensation & Perception, Thinking and Language, Cognition: Information Processing Models, Human Abilities & Skills, Various cognitive abilities involved at work place, Guidelines in Perception, Memory Failure, Working Memory (WM), WM Capacity, Human factors Implications of WM Limits, Long-term Memory, Introduction to Human Computer Interaction (HCI)-The interdisciplinary field of HCI, Computer Interface (Software + Hardware), Software Interface Design, Software Design Cycle, User System & Characteristics.</p>	9
<p>Question paper pattern:</p> <p>CIE: Question paper will be for 40 marks consisting of four-five questions. Students have to answer all questions.</p> <p>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.</p>	
<p>Text books:</p> <ol style="list-style-type: none"> 1. M. S. Sanders and Ernest J. McCormick- Human Factors Engineering and Design, McGraw Hill Inc 2. Lakhwinder Pal Singh; Work Study & Ergonomics”, Cambridge University press, 2016. 3. Khan M.I. – Industrial Ergonomics –PHI Learning, 2010 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. Martin Helander- A Guide To Human Factors And Ergonomics, Second Edition, CRC Press, 2006
2. Cecilia Berlin& Caroline Adams- Production Ergonomics: Designing Work Systems to Support Optimal Human Performance, ubiquity press London, 2017
3. Gavriel Salvendy&Tsinghua University (China)- Handbook Of Human Factors And Ergonomics, Fourth Edition, John Wiley & Sons, Inc., 2012
4. Jan Dul and Bernard Weerdmeester- Ergonomics for Beginners A quick reference guide, Second Edition, Taylor & Francis London, 2001
5. R.S. Bridger : A Introduction to Human Factors and Ergonomics 4th edition, CRC Press, 2017

https://onlinecourses.nptel.ac.in/noc19_de02/preview

https://onlinecourses.nptel.ac.in/noc23_de21/preview

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21IPOE641	CO1	Understand the fundamentals of Human Factors, ergonomics, its applications, Man-machine systems, and displays and controls.
	CO2	Understand and Apply the significance of Anthropometry in Product Design, Work station Design and Space requirements.
	CO3	Understand the concept of Musculoskeletal disorders and their relevance in work design. Apply and Use the Ergonomic Assessment Tools.
	CO4	Understand the significance of Work Environment like Heat, Noise, Illumination, Vibrations etc. On human performance and ways to reduce the exposure.
	CO5	Understand the significance of cognitive ergonomics, mental work load and human-computer interaction

Course title: Project					
Course code:	22IP65		Credits:	02	
Contact hours/week:	L:0 T:0 P:4		Total teaching hours:	-	
CIE: 50 marks		SEE: 50 marks		SEE: 03 hours	
Course Objectives: Students to <ul style="list-style-type: none"> • Form project group and identify the problem (Project) • select the guide as per their field of interest (Industry, software, design and fabrication etc) • Plan the project in such a way that they could complete within the stipulated time and cost • Prepare the report of the project plan 					
Particulars					Teaching hours
Project work shall be completed batch wise the batch size shall consist of a minimum of 2 and a maximum of 4 students (in special case 5-6 students may be permitted in a batch). Each batch of students is required to undertake a suitable project in an industry and /or in the college in consultation with the faculty guide and Head of the department. Project should be completed in two phases. In phase-I, each batch has to conduct literature survey, finalize the title plan and methodology). The batch is required to present two seminars about the progress of the project during the semester. The batch shall submit a project report at the end of the semester on the dates announced by department. Presentation of work carried out in the phase – I and Viva voce will be conducted batch wise after submission of the report.					
CIE Evaluation Scheme for Phase – I Project work					
Criteria	Problem identification	Objective and methodology	Progress report	presentation	Report writing
Weightage	20%	20%	30%	10%	20%
Evaluator	Project review team	Project review team	Guide	Project review team	Guide
Course Code		CO #	Course Outcome (CO)		
		CO1	Demonstrate the skill to form and work in group to perform the selected task.		
		CO2	Undertake problem identification, formulation and solution with respect to execution of project works		

22IP65	CO3	Devise a plan, develop concept and prepare the schedule to carry out the project.
	CO4	Exhibit the skill of evaluating and choosing better options among technical alternatives
	CO5	Communicate technical information to others by means of formal presentations, drawings and reports.

Course title: Human Factors and Ergonomics (HF & E) Laboratory			
Course code:	22IPL66	Credits:	1
Teaching hours/week:	L:0 T:0 P:2	Total teaching hours:	-
Practical ours/week	02	Total practical hours	28
CIE: 50 marks	SEE: 50 marks	SEE: 3 hours	
Course Objectives: <ul style="list-style-type: none"> To expose the students to the different aspects of human factors and its effects on Productivity To design an ergonomically sound workplace for comfortable and efficient working this leads to increase in productivity 			
Course contents			Practical Hours
1. Study and Measurement of Anthropometrics Data for different work positions and conditions. 2. Correlating heart beat and oxygen consumption rate with work output using bicycle Ergo meter, treadmill and Oxylog. 3. Study of the different types of Displays and Controls. 4. Study of factors affecting design of chairs, tables, consumer goods etc. 5. Measurement of Noise 6. Measurement of Illumination, temperature and humidity in the workplace and their effect on human performance 7. Postural Analysis- Analysis of working postures in manual work to assess the risk factors using tools like RULA, REBA etc 7. NIOSH lifting equation- Determination of lifting capacity by using NIOSH equation and find out the lifting index.			28
Question paper pattern: <ol style="list-style-type: none"> Write up with necessary programs = 15 Marks Execution = 25 Marks Oral = 10 Marks Total = 50 Marks			
Reference Books: <ol style="list-style-type: none"> HF & E Lab Manual 			
Course outcomes: On completion of the course, the student will have the ability to:			
Course Code	CO #	Course Outcome (CO)	
	CO1	Identify the role of human factors and ergonomics and also areas of application in the work system	

22IPL66	CO2	Apply the ergonomic concepts and anthropometric data, in the evaluation of existing work systems and design of new systems
	CO3	Analyze and calculate the risk level in a job which causes stress, fatigue and musculoskeletal disorders and design appropriate work systems.
	CO4	Categorize the effect of environmental factors like noise, heat stress, and illumination and vibration levels on performance.
	CO5	Design, develop and conduct ergonomic related experiments and analyze he results

INDIAN KNOWLEDGE SYSTEMS (Theory) (Common to All UG Programs)			
Course Code	:	22IKSAE67	CIE : 50Marks
Credits :L:T:P	:	1:0:0	SEE : 50Marks
Total Hours	:	15L	SEE Duration : 02Hours
Course Learning Objectives: The students will be able to			
1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.		
2	To make the students understand the traditional knowledge and analyze it and apply it To their day-to-day life.		
Modules			
Module-I			05Hrs
Introduction to Indian Knowledge Systems(IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-à-vis indigenous knowledge, Traditional knowledge vs. western knowledge.			
Module-II			05Hrs
Traditional Knowledge in Humanities and Sciences: Linguistics, Number and Measurements - Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.			
Module-III			05Hrs
Traditional Knowledge in Professional domain: Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.			
Course Outcomes: After completing the course, the students will be able to			
CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.		
CO2:	Appreciate the need and importance of protecting traditional knowledge.		
CO3:	Recognize the relevance of Traditional knowledge in different domains.		
CO4:	Establish the significance of Indian Knowledge systems in the contemporary world.		
Reference Books			
1	Introduction to Indian Knowledge System-concepts and applications , B Mahadevan, VinayakRajatBhat,NagendraPavanaRN,2022,PHILearningPrivateLtd,ISBN-978-93-91818-21-0		
2	Traditional Knowledge System in India , AmitJha,2009,AtlanticPublishersandDistributors (P)Ltd.,ISBN-13:978-8126912230,		
2	Knowledge Traditions and Practices of India , KapilKapoor, AvadeshKumarSingh,Vol.1, 2005,DKPrintWorld(P)Ltd.,ISBN81-246-0334,		
Suggested WebLinks:			
1	https://www.youtube.com/watch?v=LZP1StpYEPM		
2	http://nptel.ac.in/courses/121106003/		
3	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)		
4	https://www.wipo.int/pressroom/en/briefs/tk_ip.html		
5	https://unctad.org/system/files/official-document/ditcted10_en.pdf		
6	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf		

7	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMIInp-Jtb_p8gIVTeN3Ch27LAmPEAAAYASAAEgIm1vD_BwE
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ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	50%(CIE)	50%(SEE)
QUIZZES		
Quiz-I	Each quiz is evaluated for 05 marks adding upto 10 Marks.	*****
Quiz-II		
THEORY COURSE- (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test-I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced To 20 Marks	*****
Test-II		
EXPERIENTIAL LEARNING	20	*****
Case Study-based Teaching-Learning	--	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	--	
Video based seminar(4-5minutes per student)	--	
Maximum Marks for the Theory	---	
Practical	--	--
Total Marks for the Course	50	50

