Course title: Operations Management			
Course code:	21IP711	Credits:	03
Teaching hours/week:	L:3 T:0 P:0 S:1	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: - Operation Research			

Course Objectives:

- To understand the role of operations management (OM) in the overall business strategy of the firm.
- To understand the interdependence of the operating system with other key functional areas of the firm.
- To identify and evaluate the key factors and their interdependence for operating systems effectively.
- To identify and evaluate a range of tools appropriate for analysis of operating systems of the firm.
- To understand the application of OMs policies and techniques for service & Manufacturing sectors.

Modules	Teaching hours
Module I Introduction to Operations, Operations Functions in Organizations, Historical development, Framework for managing operations, Operations in service industries Factors affecting Productivity, The environment of operations. Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology.	**8**
Module II System Design and Capacity: Introduction, Manufacturing and Service Systems, Design and systems capacity, Capacity planning. Forecasting Demand: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing, Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, BIAS, and Tracking Signal.	**9**
Module III Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate Planning Strategies, 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, Capacity management, CRP activities. Introduction to ERP-	**11**

Module IV Scheduling and Controlling Production : Introduction, PAC, Objectives and Data requirements, Loading –Finite and Infinite Scheduling methodology, priority sequencing, capacity control. Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule. Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic. Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines.	**8**
Module V **Materials management**: Scope and functions of Materials Management, Inventory control, purchasing and store keeping. Lean Systems: Seven Wastes in Lean, Introduction to JIT, The Kanban system, Kaizen, Six-Sigma, and Poke-Yoke.	**6**

Question paper pattern: There will be two questions from each module and students have to answer at least one question from each module. Each question will carry 20 marks and consists of 1 to 3 sub-questions.

Text books:

1. Monks, J.G., Operations Management, McGraw-Hill International Editions, 1987.
2. Pannerselvam. R., Production and Operations Management, PHI, 2012.
3. Lee J Karjewski and Larry P Ritzman, Operations Management – strategy and Analysis, 6th Edn, Pearson Education Asia ,2009
4. Anil kumar and Suresh – Operations Management – New Age Publishers

Reference Books:

1. Buffa, Modern Production/Operations Management, Wiely Eastern Ltd, 8e, 2003.
2. Chary, S.N., Production and Operations Management, Tata-McGraw Hill, 5th edition, 2012.
3. Chase Jacobs Aquilano, Operations Management for Competitive Advantages, 10th Edition, 2012, TMH

E books and online course materials: http://nptel.ac.in/syllabus/110102016/
http://bookboon.com/en/operations-management-ebook

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

Course Code	CO #	Course Outcome (CO)
	CO1	Understand the historical development, current trends in OM, framework and functions relevant to the planning, design and operations of Manufacturing& Services.
	CO2	Apply an appropriate technique to aid in decision making relating to systems design, capacity planning and demand forecasting.

21IP711	**CO3**	Differentiate between Aggregate Planning & Master Scheduling and use them for allocation of load, and apply MRP and CRP techniques to plan for materials and capacity.
	CO4	Discuss the various tools and techniques used for day to day resource, planning and scheduling and apply to different production systems
	CO5	Discuss the principles of Materials Management and lean manufacturing systems

Course title: Computer Integrated Manufacturing			
Course code:	21IP721	Credits:	03
Teaching hours/week:	L:3 T:0 P:0	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE : 3 hours	

Prerequisite:

- Manufacturing automation techniques
- CNC Machine Tools

Course Objectives:

- To develop an understanding of the role of computer in manufacturing
- To introduce hardware and software components for soft automation.
- To provide an in-depth understanding of control of manufacturing, automated material handling, storage and retrieval systems.
- To introduce group technology and concurrent engineering, and develop skill in the developing automated process plans using variant and generative approaches
- To take up case studies on FMS and CIM systems.

Modules	Teaching hours
Module I Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed Database System; Distributed Communication System. Computer networks for manufacturing.	**8**
Module II Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic drafting, engineering analysis, FEM design review and evaluation. Future automated factory, CIPM, social and economic factors. Group Technology Centre.	**8**
Module III Computer Aided Manufacturing (CAM): Computer assisted NC part programming, Computer assisted robot programming, computer aided material requirements planning (MRP), computer aided production scheduling, computer aided inspection planning, Computer aided inventory planning.	**10**
Module IV Flexible manufacturing system (FMS); concept of flexible manufacturing. Integrating NC machines, robots, AGVs and other NC equipment, Computer aided quality control.	**8**
Module V Computer Integrated business functions, computer aided forecasting, office automation.	**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:

CAD/CAM and Automation by Grover

Reference Books:

- CAD, CAM, CIM by P.Radhakrishnan and S.Subramanyan, New Age International Publishers.
- Computer Integrated Manufacturing by Paul G. Rankey, Prentice Hall.
- Computer Integrated Manufacturing by Harrington J. Jr., Industrial Press, Inc., New York.
- Computer Integrated Manufacturing by K.Rathmill and P.Macconal, IFS Publications.
- Robotics Technology and Flexible Automation – S.R. Deb, TMH

E books and online course materials:

Computer Integrated Manufacturing (Kindle Edition)- **by** A.N. Venkateshwaran **Alavudeen**

Course outcomes:

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

Course Code	CO#	Course Outcome (CO)
21IP721	**CO1**	Use computers, networks, databases and communication systems for manufacturing products.
	CO2	Use computer hardware and software for automation, design, analysis, group technology etc.
	CO3	Program and use computer aided systems for manufacturing.
	CO4	Use advanced technology in shop floor for manufacturing.
	CO5	Use computers in business, forecasting and automation.

Course title: Industry 4.0			
Course code:	**21IP73OE21**	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	**09**

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 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 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. **"Smart Industry: How to Implement Industry 4.0 Successfully" by Nikolaus Schües and Walter Brenner**	

2. **"Industry 4.0: Technologies, Applications, and Challenges" by Bruno F. Silva, Mohammad S. Obaidat, Pradeep Kumar, and Eric Pardede**

Reference Books:

- "The Fourth Industrial Revolution" by Klaus Schwab
- "Design Principles for Industry 4.0 Scenarios: The Case of Smart Factory" by Denis Coelho

E books and online course materials:

- Industrial Revolution 4.0 by Stanislaw Mazur

Course outcomes:

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

Course Code	CO#	Course Outcome (CO)
21IP73OE21	**CO1**	Have learnt Industry 4.0
	CO2	Learnt CPS
	CO3	Human Robot Collaboration
	CO4	Knowledge of AI
	CO5	Cyber Security

Course title: BASICS OF NANOTECHNOLOGY AND SMART MATERIALS			
Course code:	**21IP74OE31**	**Credits:**	**03**
Teaching hours/week:	**L:3 T:0 P:0**	**Total teaching hours:**	**42**
CIE: 50 marks	**SEE: 50 marks**	**SEE : 3 hours**	

Prerequisite:

- **General Chemistry**, Physics, **Materials Science**, Biology

Course Objectives:

The primary objective of this course is to facilitate skills transfer from another relevant area of engineering or science and technology to the study of nanotechnology. Students will develop the capacity to:

- understand the basic scientific concepts underpinning nanoscience.
- understand the properties of materials and biomaterials at the atomic/molecular level and the scaling laws governing these properties.
- recognize and develop novel and innovative ideas.
- demonstrate ability in a range of laboratory methods, specifically the fabrication and characterization tools used in nanotechnology such as various microscopies, surface modifications and molecular level construction methods.
- embrace the multidisciplinary aspects of nanotechnology which is core to its understanding and engage positively with people and ideas in many disciplines.
- appreciate the emerging role of nanotechnology in society, the regulatory framework within which it operates and the ethical issues it raises.

Modules	Teaching hours
Module I Introduction: Fundamental Science behind nanotechnology (Electrons – atom and iron – Molecules – metals – other materials – Bio-system – molecular recognition – Electrical conduction and Ohm's Law – Quantum mechanics and quantum ideas – Optics). Visions and Objective of Nanotechnology.	**05**
Module II	**05**

Introduction and Definition of Nanotechnology : Introduction, Definition, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: NanoTechnology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities	
Module III Measuring and Making Nanostructures: Scanning Probe instruments – Spectroscopy – Electrochemistry – Electron microscopy. Tools to make Nanostructures – Scanning Prope Instruments – Nanoscale Lithography –Dip pen Nanolithography – E-Beam Lithography – Nanosphere lift off lithography – Molecular synthesis – Self assembly – Nanoscale crystal growth – Polymerisation - Nano CAD. **Smart Materials:** Introduction to smart materials – Self – healing structures – Recognition – Seperation – Catalysis – Heterogeneous nanostructures and composites.	**10**
Module IV **Sensors:** Encapsulation - consumer goods – Nanoscale sensors – Electromagnetic sensor – Biosensors – Electronic noses. **Nanotechnology in Different, Fields**: Automobile, Electronics, Nanobiotechnology, Materials, Medicine, Dental care, Nanocomputers, Power storage, Nanotechnology product.	**10**
Module V Biomedical Applications: Drugs – Drug delivery – Photodynamic theraphy – Molecular motors – neuro-electronic interfaces – protein engineering – Nano-luminescent tags. **Latest Developments in Nanotechnology:** Introduction, Current situation, Future Assumptions, Latest Developments, Nano-copters , Nanotubes, Biosensors, Nano structure fluid, Computers, Plastic electronics, Light emitting diodes, Solar cells, Other Developments	**12**
Question paper pattern: **CIE:** Question paper will be for 40 consisting of 4 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: Mark Ratner & Daniel Ratner, "Nano Technology", Pearson Education (Singapore) Pvt.Ltd., 482, F.I.E. Patparganj, 2003, Delhi –110 092.	
Reference Books: 1. Michelle Simmons, "NanoTechnology: Basic Science and Emerging Technologies", Chapman and Hall/CRC, June 2002.	

2. Bharat Bhushan, " Springer Handbook of Nanotechnology", Springer, February 2004.

3. Frank J. Owens, "Introduction to Nanotechnology", Willey –Inter-science, May 2003.

E books and online course materials:

- **Nanotechnology by Wikibooks, 2010**

Course outcomes:

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

Course Code	CO#	Course Outcome (CO)
21IP74OE31	**CO1**	have a sound knowledge in multidisciplinary areas of nanoscience.
	CO2	be prepared to work in a high tech work force or pursue a research higher degree in Nanotechnology.
	CO3	design and carry out experiments using both classical and novel science techniques and Protocols.
	CO4	appreciate that there are the relationships and connections across the sciences and non-science disciplines are core to nanotechnology and understand such relationships and connections.
	CO5	Students can work in the latest developments of nano-technology like, Nanotubes, Biosensors, Nano structure fluid, Computers, Plastic electronics, Light emitting diodes, Solar cells

Course title: Project			
Course code:	**21IPP75**	Credits:	10
Contact hours/week:	**10**	Total teaching hours:	-
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

Course Objectives:

In phase-II, the project batch has to execute and complete the project. 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, viva voce will be conducted batch wise after submission of the report.

CIE Evaluation Scheme

Criteria	Execution of work	Progress report	Presentation	Report writing
Weightage	30%	30%	20%	20%
Evaluator	Project review team	Guide	Project review team	Guide

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21IPP751	**CO1**	perform self study and exhibit the skills of self learning by demonstrating sound technical knowledge on the topic selected for project work
	CO2	execute the selected task with team work as per the plan and schedule demonstrating ethics and professional responsibility
	CO3	design solution to selected complex engineering problem using modern tools and provide reasonably acceptable solution to satisfy desired goals, and environmental sustainability
	CO4	prepare a well organized and compiled thesis
	CO5	Communicate technical results, information and conclusions to others by means of formal presentations.

Course title: Massive Open Online Courses (MOOCs)			
Course code:	**21AEC76**	Credits:	02
Teaching hours/week:	-	Total teaching hours:	-
CIE: 50	SEE: 50	SEE: -	

Course Objectives:

Students to register for MOOCs like NPTEL, SWAYAM etc of their interest which will count covered in the Program and appear for the online examination. After successful completion of the course students should submit the certificate to the Controller of Examination

Course Title: Digital Manufacturing			
Course code:	**21IP73OE22**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

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Course Objectives:
The objectives of the course is to make the student understand the concept of Digital Manufacturing, software and devices required, computer languages used to develop the content, utilize this knowledge to develop the applications for prototyping, simulations, training, etc.

Modules	Teaching hours
Module I Introduction to Digital Manufacturing: Definition of digital manufacturing, Historical perspective on industrial production and outlook, Industrial Revolutions, Industry 4.0, Cyber-physical system, Factory of the future, Operation Mode and Architecture of Digital Manufacturing System. Learning Outcomes: At the end of this unit, the student will be able to 1.discuss on the historical perspective on industrial production (L2) 2.explain on the concept of Industry 4.0 (L2) 3.explain the architecture of digital manufacturing system. (L2)	**8**
Module II Cad Modeling: Design process and role of CAD, Types and applications of design models, Three dimensional modelling schemes, Wire frames and surface representation schemes, Solid modelling - Parametric modelling, Assembly modelling. Learning Outcomes: At the end of this unit, the student will be able to 1.discuss on design process and role of CAD (L2) 2.explain the types and applications of design models (L2) 3.summerize on three dimensional modelling schemes (L2)	**8**
Module III Reverse Engineering: Need, Reverse engineering process, Reverse engineering hardware and software, Geometric model development. Computer Aided Manufacturing: Component modelling, Machine and tool selection, Defining process and parameters, Tool path generation, Simulation, Post processing. Learning Outcomes: At the end of this unit, the student will be able to 1.explain the need of reverse engineering (L2) 2.discuss on hardware and software used in reverse engineering (L2) 3.explain on tool selection and process and parameters in computer aided manufacturing (L2).	**8**
Module IV	**8**

Additive Manufacturing for Digital Transformation: Introduction to additive manufacturing, Additive manufacturing process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, Material extrusion, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software. Learning Outcomes: At the end of this unit, the student will be able to 1.explain the additive manufacturing process chain (L2) 2.discuss on classification of additive manufacturing process based on initial state of materials (L2) 3.explain the processes used in additive manufacturing for a range of materials (L2)	
Module V **Concept Modelers, Translators and 3D Printing Software:** Introduction, Principle, Thermo jet printer, Sander's model market, 3- D printer, Genisys Xs printer, JP system 5, object quadra System-Rapid proto typing. Standard interface to convey geometric description from CAD package to Rapid prototyping system, Stereo Lithography (STL)file, Initial Graphics Exchange Specification(IGES)file, Hewlett-Packard Graphics Language(HP/GL) file. Additive manufacturing software for editing features and to export files to printers: Ansys, Autodesk Netfabb, 3dSystems, Materialise Magics, Solid Edge, Amphyon. **Learning Outcomes:** At the end of this unit, the student will be able to 1.explain the principle and working of 3D printers (L2) 2.discuss on suitable interface to convey geometric description from CAD package to RP system (L2) 3.explain on suitable software for editing features and to export files to printers (L2)	**10**
Question paper pattern: **CIE:** Question paper will be for 20 marks, 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. Zude Zhou Shane (Shengquan) Xie Dejun Chen,"Fundamentals of DigitalManufacturing Science''Springer Series in Advanced Manufacturing,2012 (Unit-I) • 2. Ibrahim Zeid and Sivasubramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011. (Unit-II)	

- 3. Vinesh Raja and Kiran J Fernandes, “Reverse Engineering- An Industrial Perspective”, Springer-Verlag, 2008 (Unit-III)
- 4. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 3rd Edition, World scientific publications, 2014.(Unit-IV&V)

Reference Books:

- 1. Pham D T and Dimov S, “Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping”, Springer-Verlag, 2001.
- 2. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, Springer, 2005.
- 3. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer, 2004.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21IP73OE22	**CO1**	Explain Architecture of Digital Manufacturing System (L2)
	CO2	Discuss on the role of CAD and design process in digital manufacturing (L2)
	CO3	Explain the application of reverse engineering / discuss on techniques for processing of CAD models for digital manufacturing (L2)
	CO4	Explain the principal and process involved in development of parts by additive manufacturing (L2)
	CO5	Discuss on the use of digital manufacturing equipment / explain the role of software in digital manufacturing (L2)

Course title: Mechatronics			
Course code:	**21IP712**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite- -			

Course Objectives:

- To educate students about the Mechatronics and its components.
- 2. Encouraging them to understand and participate in endower of Automation Technology for all fields of engineering

Modules	Teaching hours
Module I Definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics An over view of Mechatronics, Design of Mechatronics system. Measurements system and function of main elements of measurement systems. Need for Mechatronics in industries. Objectives, advantages and disadvantages of Mechatronics. Microprocessor based controllers. Principle of working of automatic camera, engine management system, automatic washing machine. Definition and classification of transducers. (No detailed discussions on different type of transducers).	**9**
Module II Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall Effect sensors. MICROPORCESSOR: Introduction, Microprocessor based digital control. Digital member system, binary and hexadecimal number system, Logic functions, Data word representation basic Elements of control systems.	**9**
Module III Microprocessor Architecture: 8085A processor architecture Terminology-such as. CPU memory and address. ALU, assembler, data registers. Fetch cycle; write cycle, state, bus interrupts. Elements of Machine: Structure, guide ways - Friction, Antifriction and Frictionless guide ways. Merits and demerits. Drives - Recalculating ball screw and nut. Concept of stick-slip phenomenon, Concept of Preloading of ball nuts. Roller screw - planetary roller screw, recalculating roller screw. Spindle and spindle bearings in machine tool.	**8**
Module IV Electrical Actuators : Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing Method of Preventing bouncing of mechanical Triacs, Transistors, Darlington pair. Electrical actuator. Hydraulics Actuators; Valves -	**8**

Classifications, Pressure Control vales - Pressure relief values, Pressure regulating/reducing valves, Pressure sequence valve.	
Module V Flow control valves - Principle, needle valve, globe valve. Direction control valve - sliding spool valve, solenoid operated. Symbols of hydraulic elements. SIGNAL CONDITIONING: Concept, necessity, op-amps, protection, filtering, wheat stone bridge - Digital - Multiplexer. data acquisition.	**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 4 sub-questions.

Text books:
1. Mechatronics - Principles, Concepts and applications – Nitaigour and Premchand, Mahilik - Tata McGraw Hill -2003
2. Mechatronics - W. Bolton, Pearson Education Asia - 2nd Edition 2000

Reference Books:
1. Automatic to Mechatronics and measurement systems - David G. Alciatore& Michel BiHistad - Tata McGraw Hill - 2000
2. Mechatronics - H.D. Ramachandra - Sudha Publication - 2003, Mechatronics by HMT Ltd. Tata McGraw Hill - 2000
3. Mechatronics System design by Devadas Shetty and Richard A. Kark - Thomas Learning - 1997.
4. Mechatronics an Introduction by Robert H Bishop - CRC
5. Mechatronics systems Fundamental by Rolf Isermann - Springer

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

Course Code	CO #	Course Outcome (CO)
21IP712	**CO1**	Understand Mechatronics, multidisciplinary scenario, mp based controllers, transducers.
	CO2	Learn sensors, microprocessor, logic control, control system, number system
	CO3	Explain m p architecture, elements of machine structure, guide ways, bearings
	CO4	understand electrical actuators, hydraulic actuators, bouncing and de bouncing of switches
	CO5	Analyze flow control valves, signal conditioning, op amps, multiplexers

Course title: Project Management			
Course code:	**21IP722**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite -			

Course Objectives:

- To provide an insight about Project Life Cycle, Project Team & Project Scheduling.
- To expose the Students to the applications of tools & techniques of Project Management.
- To understand Project co-ordination & control methods
- To know the various performance measures in project management

Modules	Teaching hours
Module I Concepts of Project Management: Concept of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management	**8**
Module II Project Planning and Estimating: Feasibility report, phased Planning, Project planning steps, objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability	**8**
Module III Organizing and Staffing The Project Team: Skills and abilities required of project manager, Authorities and responsibilities of project manager, Project organization and types, accountability in project execution, controls, tendering and selection of contractors	**8**
Module IV Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Technique (PE'RT) and Critical path method (CPM) Planning. Co-ordination and control, role of MIS	**9**
Module V Performance Measures in Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management, Project management and environment. Case studies in project management covering project planning, scheduling, use of tools and techniques and performance measurement	**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 Chaudhry S., Project Management.
2. Project Management a System approach to Planning Scheduling & Controlling, Harold
Kerzner, CBS Publishers and Distributors.

Reference Books:

1. Project Management - Beningston Lawrence-McGraw Hill-1970.
2. PERT & CPM - L.S. Srinath, Affiliated East West Press Pvl. Ltd.
3. A Management Guide to PERT and CPM, WEIST & LEVY, Eastern Economy of PHI
4. Project Management with PERT and CPM, ModerJosep and Phillips cerel R., 2nd edition,
New York VAN Nostrand, Reinhold- 1976
5. Project Planning analysis selection implementation & review - Prasannachandra, ISBNO-07-
462049-5. .
6. Project planning, Scheduling & control, James P. Lewis, Meo Publishing company.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21IP722	CO1	Identify categories of projects and also roles and responsibilities of a Project leader.
	CO2	Plan and prepare estimate for a given project
	CO3	Perform tendering and selection of contractors in a project
	CO4	Evaluate project work with respect to time frame of completing a project.
	CO5	Assess the performance in a project by performance indicators

SOFTWARE PROJECT MANAGEMENT		
Subject Code : **21IP74OE32**	Credits:3	CIE: 50
Number of Lecture Hours/Week(L:T:P)	**3:0:0Hrs**	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
Prerequisites: Nil		

Course Objectives:

- To understand the basic principles of software project management
- To have a good knowledge of project selection and estimation
- To understand the project risks and plan activities
- To have a understanding of monitoring and control of projects
- To understanding the managing of teams and quality aspects

MODULES	Teaching Hours
Module– I **PROJECT PLANNING AND PROJECT EVALUATION:** Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives –Project success and failure, Management Principles – Management Control –Traditional vs Modern Project management practices, Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	**08 Hrs**
Module-II **APPROPRIATE PROJECT SELECTION AND EFFORT ESTIMATION :** Selecting appropriate project approach, Build or Buy, Software process and Process Models – choosing methodologies and technologies, Choice of Process models – Waterfall model, Spiral model, software prototyping, incremental delivery, Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II A Parametric Productivity Model - Staffing Pattern.	**09 Hrs**
Module-III **ACTIVITY PLANNING AND RISK MANAGEMENT:** Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling, Gantt chart, – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method –Risk, categories of risk, Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation, Nature of Resources, – Creation of critical patterns – Cost schedules.	**09 Hrs**

Module– IV **PROJECT MONITORING AND CONTROL:** Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts, Types, Terms, Contract Management, Software Quality-Importance of software quality, Quality management systems, Quality Plans.	**08 Hrs**
Module– V **STAFFING IN SOFTWARE PROJECTS:** Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures , Organisation and Team Structures, – Virtual teams – Communications genres – Communication plans, Leadership.	**08 Hrs**

Question Paper Pattern

The question paper will have ten questions.
There will be 2 questions from each module, covering all the topics from a module.
The students will have to answer 5 full questions, selecting ONE full question from each module**.**

Text book:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

ReferenceBooks:

1. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011
2. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.
4. Pankaj Jalote – Software Project management in Practice

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

Course code	CO #	Course Outcome (CO)
21IP74OE32	**CO1**	Describe the basic concepts of software project management
	CO2	Apply project selection and estimation techniques in real world
	CO3	Identify and apply the techniques like CPM, PERT and risk management
	CO4	Evaluate the projects and track project deadline by monitoring & control
	CO5	Work in teams and communicate with people.