SEVENTH SEMESTER

SEMESER: VII   **INDUSTRIAL AND PRODUCTION ENGINEERING**

S.NO	Subject / Course Name	Hours / Week				Examination		
		Lecture	Tutorial	Practical	Credits	CIE	SEE	TOT
SEMESTER – VII								
THEORY								
19IP71	Operations Management	04			04	50	50	100
19IP72	CIM	04			04	50	50	100
19IP742	MIS	03			03	50	50	100
19IP733	Industry 4.0	03			03			
19IP-OE	Open elective	03			03	50	50	100
19IPL71	Software application Lab –II	01		02	02	50	50	100
19IPS72	Seminar/Case study/Group Work	01			01	50	50	
19IPP73	Project Phase –I	01		04	02	50	50	100
	Total	20		06	22	400	400	800

Electives: VII SEM

SUB CODE	Group 3	SUB CODE	Group 4
19IP731	Product design and manufacturing	19IP741	Marketing Management
19IP732	Additive manufacturing	19IP742	Management Information System
19IP733	Industry 4.0	19IP743	Product Data Management

Open Electives VII SEM

19IP7XX	Engineering Economics
19IP7XX	Enterprise resource planning
19IP7XX	Project management

S.NO	Subject / Course Name	Hours / Week				Examination		
		Lecture	Tutorial	Practical	Credits	CIE	SEE	TOT
SEMESTER – VIII								
THEORY								
19IP83X	Elective-F	03			03	50	50	100
19IP8OE	Elective-G (Open elective)	03			03	50	50	100
19IP84	MOOCs/NPTEL	-	-	-	01	-	-	-
PRACTICAL								
19IP85	Seminar	-	-	02	01	50	50	100
19IPP86	Project Phase –II			06	08	50	50	100
	Total	06	-	08	25	200	200	400

Electives: VIII SEM

SUB CODE	Group F	SUB CODE	Group G (Open Elective)
19IP831	Virtual Reality	19IP8OE	Quantitative Methods For managerial Deecision.
19IP832	Strategic Management		
19IP833	Product Design and Manufacturing		
19IP834	Recent Trends in Manufacturing and Management		

Course title: Operations Management			
Course code:	19IP71	Credits:	04
Teaching hours/week:	04	Total teaching hours:	52
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, Thetrend: Information and Non-manufacturing systems, Factors affecting Productivity, International dimensions of productivity, Theenvironment of operations, Production systems decisions- a lookahead. 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.	**10**
Module III Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate Planning	**12**

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-	
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.	**12**
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.	**10**

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

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)

21IP71	**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.
	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:		19IP72	Credits:	04
Teaching hours/week:		04	Total teaching hours:	52
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.	**10**
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.	**10**
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.	**12**
Module IV Flexible manufacturing system (FMS); concept of flexible manufacturing. Integrating NC machines, robots, AGVs and other NC equipment, Computer aided quality control.	**10**

	Module V	10
	Computer Integrated business functions, computer aided forecasting, office automation.	

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:
1] 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)
21IP72	**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 code:	Course; Industry 4.0	19IP733	Credits:		03
Teaching hours/week:	Teaching hours/week:	03	Total teaching hours:		42
CIE: 50 marks	CIE: 50 marks	SEE: 50 marks			SEE: 03 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.   8

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.)   9

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)   8

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)   9

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.   8

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 Ind

Course title: Marketing Management			
Course code:	19IPOE752	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

Course Objectives:
After studying this course, students will be able to understand the environment within which the marketing operates and the various concepts which makes marketing effective.

Modules	Teaching hours
Module I **Introduction**: Definition of marketing and marketing management, core marketing concepts, micro and macro environment of marketing.	6
Module II **Consumer markets and Buying Behaviour**: Types of Consumer Products, Characteristics affecting consumer behaviour, types of buying decision, buying decision process. **Business markets:** Classification of industrial products, characteristic of business market, participants in buying process, determinants of industrial market demands, industrial buying process.	10
Module III **Marketing Information System:** Components of MIS, marketing research, procedure of marketing research. **Product Planning and Development:** Classification of products, product mix, product line, major stages in product planning and development, product life cycle.	10
Module IV **Branding Labelling and Packaging:** Functions, types of branding. Functions, types & merits and demerits of labelling and packaging. **Pricing:** Importance, objectives and factors affecting pricing. Procedure for price determination.	8
Module V Types of marketing channels and their functions.	8

Advertisement and Sales promotion: Objectives and functions of Advertisements, media for advertisement, sales promotion- objectives, types and advantages.

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.Philiphs Kotler: Principles of Marketing Prentice Hall
  2. Gandhi :Marketing, Tata McGraw hill

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

Course Code	CO #	Course Outcome (CO)
21IP7OE	**CO1**	Understand the role of marketing in success of an organization and the environment within which it operates.
	CO2	Understand and analyze the various factors affecting consumer behaviour and business behaviour.
	CO3	Understand the role of various components of MIS in order to develop a Marketing Plan and Identify the steps in product planning & development
	CO4	Apply the concept of price determination of product and major decisions with respect to products
	CO5	understand the role of marketing channels in enhancing the profitability and decisions regarding advertisement and sales promotion

Course title: Management Information System			
Course code:	**19IP731**	Credits:	03
Teaching hours/week:	**03**	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

Course Objectives:

The main objective of the subject is to make the students aware of modern information system and how they are used in the current business process.

Modules	Teaching hours
Module I **Foundation concepts**: Foundation of information systems in business – Information systems and technologies, business applications. Developments and management, competing with information technology – Fundamentals of strategic advantage. **Review of information technologies I:** computer hardware – computer systems , end user and enterprise computing , computer peripherals, input , output and storage technologies.	**9**
Module II **Review of Information Technologies II**: Computer software – Application software, end user application, system software , computer system management , data resources, Technical foundation of database management , Telecommunications and networks – Overview of Telecommunications and Networks , Technical telecommunications alternatives.	**8**
Module III **Business Applications I**: The internet worked E-business Enterprise - The internet, Intranets and extranets in business, Enterprise communication and collaboration. **Business application II**: Business systems – cross-functional E-business systems, functional E-business, Electronic commerce systems – Electronic commerce fundamentals, commerce applications and issues	**8**
Module IV **Business applications**: E-business decision support – Decision support in E-business, Artificial intelligence Technologies in Business. **Development process**: Developing E-business strategies – E-business planning fundamentals, Implementing E-business strategies, Developing E-business solutions.	**9**
Module V **Management Challenges**: Security and ethical challenges of E-Business – Security, Ethical and societal challenges of E-Business, Security	**8**

management of E-Business.

Text books:
1. L .S. Sadagopan "Management Information Systems" Prentice Hall of India New Delhi 1997.

Reference Books:
1. Davis G.B and M.olson'Management information systems" McGraw Hill New York, 1985
2. O'brienJ.A.Jr., "Management information systems" McMillanNew York, 1995
3. Date C.J., "An Introduction To database Systems" 6 Ed. Vol-1 ,Addison Wesley, 1995
4. Turban E and Meredith J.R. "Fundamental of Management Science" IRWIN inc 1991.
5. Murdick R.G and Ross ,J.E "Information systems for modern management" PHI.

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

Course Code	CO #	Course Outcome (CO)
21IP742	**CO1**	The students can use the knowledge of fundamental concepts of MIS in business –business applications, developments and management and learn the necessary computer hardware required for the purpose.
	CO2	The student can use application software, system software, data resources, database management system and telecommunication networks for e-business.
	CO3	The students can use internet, intranets and extranets for business, Enterprise communication, E-business systems, Electronic commerce and commerce applications.
	CO4	The students will be able to use decision support systems, Artificial intelligence Technologies for business and can develop strategies and solutions.
	CO5	The students will be able to use security management in e-business with all the ethics.

Course title: Product Data Management				
Course code:	**19IP743**	Credits:		03
Teaching hours/week:	**03**	Total teaching hours:		42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours		

Course Objectives:

The main objective of the subject is make the student capable of using Product Data Management by learning its components like, Configuration management, Projects and roles , Change management and Generic products and variants

Modules	Teaching hours
Module I **Introduction:** Introduction to PDM-present market constraints-need for collaboration Internet and developments in server-client computing. **Components of PDM:** components of a typical PDM setup-hardware and document management-creation and viewing of documents -creating parts-version Control of parts and documents -case studies.	**9**
Module II **Configuration management:** Base lines-product structure-configuration management-case studies.	**8**
Module III **Projects and roles:** creation of projects and roles -life cycle of a product-life cycle management –automating information flow -work flows -creation of work flow. Templates-life cycle –workflow integration -case studies.	**8**
Module IV **Change management:** Change issue-change request-change investigation-change proposal-change activity , case studies.	**8**
Module V **Generic products and variants:** Products configuration-comparison between sales configuration and products generic-generic product modelling in configuration modeller-use of order generator for variant creation – registering of variants in product register-case studies.	**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.

Reference Books:
1. David Bedworth. Mark Henderson & Philips Wolfe, "Computer Integrated Design and Manufacturing", McGraw Hill Inc., 1991.
2. Terry Quatrain, "Visual Modelling with Rational Rose and UML ", Addison Wesley, 1998.
3. Wind-chill R5.0 Reference manuals, 2000,
4. "Implementing and integrating product data management and software configuration management" by IvicaCmKovic, Ulfaskwnd and Annita person dohlgurst publisher Artechhouse.

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

Course Code	CO #	Course Outcome (CO)
21IP743	**CO1**	Students will be able to create documents, view them, create part versions by understanding the market constraints, need for collaboration, Internet and developments in server-client computing.
	CO2	The will be able configure the product by understanding its structure and mange.
	CO3	Students can be able to create projects and roles, understand life cycle of a product, its management and automating information flow, workflow integration
	CO4	Students will be able to use change management through case studies.
	CO5	Students can make comparison between sales configuration and products generic and use order generator for variant creation.

Course title: Software Application Lab - II			
Course code:	**19IPL71**	**Credits:**	**01**
Teaching hours/week:	**2 Hrs/Batch**	**Total teaching hours:**	**26**
CIE: 50 marks	**SEE: 50 marks**	**SEE: 03 hours**	

Prerequisite:

- Software Application Lab-I
- Computer programming
- Basics of Computer

Course Objectives: The objective of the course is to expose the students to software development and implementation process using various tools and techniques and computer languages.

Particulars	Teaching hours
● Briefing of project/assignment ● Planning of project/assignment ● Training students in necessary software tools and computer language. ● Development of computer program for project/assignment ● Testing and implementation of developed program	2 2 08 12 02

Note: The project/assignment is a group activity consisting of 3 to 6 members in a team. The project/assignment will be carried out offline for duration of 24-28 hours.

Question paper pattern:

1. Write up with necessary programs = 16 Marks
2. Execution   = 25 Marks
3. Oral   = 10 Marks
Total   = 50 Marks

Text books:
1. Manual of SAL-II
2. Learn Visual Basic: A Step-By-Step Programming Tutorial Kindle Edition
by Philip Conrod and Lou Tylee

Reference Books:

1. "Programming in Visual Basic" by McBride
2. "Programming in Visual Basic 6.0 with Working Model CD-ROM" by Julia Case Bradley and Anita Millspaugh
3. "Programming in Visual Basic. Net" by Julia Case Bradley and Anita Millspaugh
4. "Programming in Visual Basic 6" by Ivan Bayross

Course outcomes:

	On completion of the course, the student will have the ability to:	
Course Code	**CO #**	**Course Outcome (CO)**
21IP76	**CO1**	Use various software tools and computer languages for software development.
	CO2	Make requirement analysis and accordingly design database.
	CO3	Write programs for solving given problems.
	CO4	Implement RDBMS
	CO5	Implement and test developed software

Course title: Project Phase-I				
Course code:		**19IP78**	**Credits:**	**04**
Contact hours/week:		**8 hrs/Batch**	**Total teaching hours:**	**-**
CIE: 50 marks		**SEE: 50 marks**	**SEE: 03 hours**	

Course Objectives: Students to
- 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)**

19IP78	**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	
	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.	

EIGHTH SEMESTER

SEMESTER: VIII   INDUSRTIAL AND PRODUCTION ENGINEERIN

Course Title: Virtual Reality			
Course code:	**19IP831**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	

Prerequisite:

- Essentials of IT
- Basics of computer

Course Objectives:
The objectives of the course is to make the student understand the concept of Virtual Reality, devices required to create virtual environment, computer languages used to develop VR content, software packages to be used and utilize this knowledge to develop the applications for prototyping, simulations, training, walk trough effects etc.

Modules	Teaching hours
Module I **Review of Computer Graphics:** Review of computer graphics, 2D graphics, 2D primitives and transformations. Algorithm to digitize the graphic entities, rasterization, 3D graphics. **Primitives:** 3D primitives and transformations, projections and viewing, algorithms for hidden line removals. Lighting, Shading and ray tracing.	**9**
Module II **VR Devices: Input devices** - Track balls, 3D Mouse, data gloves, Virtual hand and trackers. **Output devices:** graphic terminal, stereo glasses, head mounting devjces, vision dome, caves.. **Applications:** Virtual prototyping, behaviour simulation, digital mock up, walk thru/flythrough. Virtual training/simulation, Micro Electro Mechanical Systems (MEMS) and nanotechnology.	**9**
Module III	**8**

VR Modelling language: History, Concepts, syntax, basic nodes-group, transform switch, LOD etc, geometry nodes indexed face set, indexed line set, coordinate, textures etc. **Sensors:** sensor nodes - time sensor, touch sensor, sphere sensor, cylinder sensor and proximity sensor .	
Module IV **Tutorials and samples:** VRML authoring tools - 3D studio MAX, Cosmo World, VRML Pad (editor). VRML Viewing tools - Cosmo, player, auto value, SGI's open inventor.	**8**
Module V Virtual collaborative tools-V collab, scripting - VRML Script and JAVA Script.	**08**

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:

- JanesD,Foley et al., "Computer Graphics-Principles and practice" Second edition. inC,Addision -Wesley 1997.
- Jed Hartman and Josie wernecke, "The VRML- 2.0 hand book" Addision-Wesley 1997.
- R Carey and G Bell "The Annocated VRML 2.0 hand book Addision-Wes!ey 1997.

Reference Books:

- Future Presence: How Virtual Reality Is Changing Human Connection, Intimacy, and the Limits of Ordinary Life by Peter Rubin
- **Maya: The World as Virtual Reality** Kindle Edition by Richard L. Thompson

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

Course Code	CO #	Course Outcome (CO)
21IP831	**CO1**	Create and work with 2D and 3D computer graphics.
	CO2	Handle and use input and output devices used for creating virtual environment.
	CO3	Work and use virtual reality for, virtual prototyping, behaviour simulation, digital mock-up, walk through, virtual training, micro electro mechanical systems and nanotechnology.
	CO4	Create and use virtual Sensor nodes through VRML script, java script, VRML authoring and viewing tools.
	CO5	Use V-collab for Practical applications of virtual reality.

Course title: Technology Management			
Course code:	**19IP833**	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours	
Prerequisite: -			

Course Objectives:

After studying this course, students will be able to develop skills in project management applied to technology development.

Modules	Teaching hours
Module I **The Concept of Technology**: Introduction, The nature of knowledge, Aspects of classification, Concept and Meaning of technology, The character of a specific technology, Scope of technology, Examples of classification of technology, Scale of technology information, Levels of technology, Technology as an environment.	6
Module II **Nature of Technological Change :**Introduction, Meaning of technological change, Concept of invention, Nature of innovation, Emergence of new technologies, Life cycle of a technology, Motivation for technological change, Nature of technological progress, Nature of mature technology, Nature of diffusion, Technological convergence. **The Economics of Technology:** Introduction, Meaning of technological economics, Examples of technological economics, Scope of technological economics, Engineering economics, Production economics, Concept of economy of scale, Concept of optimum size, Technology as a commodity, Technology at the macro-economic level.	10
Module III Business mission, Where is the business? Concept of business strategy, Capability for strategic planning, Corporate technology strategy, Competitive technology, Focus of strategy, Technological alliances,	6

Realization of strategy, Technology crisis.	
Module IV **Analysis for Technology Strategy:**Introduction, Technology assessment, Technology forecasting, Main techniques of technology forecasting, Technology forecasting system, Yield of technology forecasting. **The Realization of New Technology:** Introduction, Concept of R&D, R&D policy, Stimuli for innovation, Sources of innovation, Intelligence function of R&D, Management of R&D, R&D team, Effectiveness of R&D, Marketing aspects of R&D, Finance for R&D, Design, Development, Manufacture and Marketing, Reduction of development lead time, Patterns for new technology development, Remaining a going concern.	**10**
Module V **The Adoption of New Manufacturing Technology:** Introduction, Manufacturing strategy, Introduction of new technology, Challenges of factory automation, Stages of factory automation, Manufacturing cells, FMS, CIM, CAD/CAM, Intelligent manufacturing systems, Operation of new technology, Change management, People and technology at work, Work structures. **Technology- An Instrument of Composition:** Introduction, Securing competitive advantage, Technological competition analysis, Technological leadership, Adoption of new technology, Marketing a new technology product, Retention of competitive advantage.	**10**

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.   Paul Lowe, The Management of Technology : Perceptions and Opportunities, **Chapman and Hall**, London,1995

Reference Books:
   1. Frederick Betz, Strategic Management of Technology, **McGraw-Hill Inc**, 1993.
   2.Rastogi, P.N., Management of Technology and Innovation Competing Through Technological Excellence, **Sage Publications**,1995.

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

Course Code	CO #	Course Outcome (CO)

	CO1	Understand the necessary infrastructure for development/acquisition, commissioning and executions phases of technology management
	CO2	Apply decision making processes and techniques.
21IP832	**CO3**	Apply Manufacturing Enterprise Work Systems in support of Technology Introduction, like Design and Development, Implementation, Cost Implications, Reliability-based Assets Management, Work Maintenance Systems for preservation of Technology and Product Integrity.
	CO4	Plan and manage projects in terms of time, cost and human resources.
	CO5	Learn techniques to support decision in financial aspects and other subjective matters

Course title: Product Design and Manufacturing			
Course code:	19IP734	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 3 hours	
Prerequisite: Strength of Materials, Machine design, Manufacturing Process			

Course Objectives: To study;
   Student has to study
● Essential factors of product design and production-consumption cycle
● Various strategies adopted for product design (PD) practice
● Design for production of metal, plastic, rubber and ceramic parts
● Engineering stress-strength concept for efficient design
● Economic factors influencing design, role of ergonomics in design and modern approaches to PD

Modules	Teaching hours
Module I **Introduction to product design**: Definition of product design, essential factors of product design, production-consumption cycle-production, consumption, distribution, consumption and recovery or disposal. **Product design practice and industry**: Product strategies, time to market, analysis of the product, the three S's, standardization Renard series(preferred numbers), simplification, the designer and his role, The industrial design organization, basic design considerations, problems faced by industrial designer, procedure adopted by industrial designers, role of aesthetics in product design, functional design practice.	9
Module II	

Product design practice and industry: Product strategies, time to market, analysis of the product, the three S's, standardization Renard series(preferred numbers), simplification, the designer and his role, The industrial design organization, basic design considerations, problems faced by industrial designer, procedure adopted by industrial designers, role of aesthetics in product design, functional design practice. **Design for production – metal parts**: Producibility requirements in the design of machine components, forging design pressed component design, casting design, design for machine ease, ease of location and clamping, die casting and special castings, design for powder metallurgical parts, expanded metal and wire forms. **Design with plastics, rubber and ceramics**: Approach to design with plastics, plastic bush bearings, gears in plastics, fasteners in plastics, rubber parts, design recommendations for rubber parts, distortion in rubber, dimensional effects, tolerance, ceramics and glass parts, production design factors for ceramic parts, special considerations for design of glass parts and dimensional factors and tolerances.	**8**
Module III **Engineering concept of efficient design:** Force-flow concept, balance of stress and strength, failure criteria, design objectives, design for static strength, design for deflection, design for rigidity, design for impact strength, toughness, uniform stress distribution, tension versus compression. **Economic factors influencing design**: Product value, design for safety, reliability and environmental considerations, manufacturing operations in relation to design, economic analysis, profit and competitiveness, break-even analysis economics of a new product design(Samuel Eilon model).	**9**
Module IV **Human engineering considerations in product design:** human being as applicator of forces, anthropometry, man as occupant of space, the design of controls, the design of displays, man-machine information exchange	**8**
Module V **Value engineering:** Historical perspective, nature and measurement of value, maximum value, normal degree of value, importance of value, the value analysis job plan, creativity, steps to problem-solving and value analysis tests, value engineering idea generation check list, cost reduction through value engineering	**8**
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. Sub question may consist of definitions, derivations and problems	
Text books:	

• A.C.Chitale and R.C.Gupta, Product design and manufacturing, Prentice-Hall of India Pvt.Ltd., New Delhi, 2005	

Reference Books:
- Vijay Gupta and P.N.Murthy, an introduction to engineering design methods, TATA McGraHill Publishing company limited, 1980.
- chow W.W., cost reduction in product design, Van-NosrtandReihold, New York, 1978
- Product design and development by Karl T. Ulrich & Steven D. Epinger, Tata McGra Hill, 3rd Ed., 2003.

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

Course Code	CO #	Course Outcome (CO)
	CO1	Understand and apply various strategies in product design practice & manufacturing (PD & M)
	CO2	Design for production of metal, plastic, rubber and ceramic parts
	CO3	Apply mechanical properties and economic factors in PD & M
21IP731	CO4	Understand and apply human factors and ergonomics in PD & M
	CO5	Reduce the cost of the product through value engineering

Course title: Recent Trends in Manufacturing and Management				
Course code:	19IP835	Credits:		03
Teaching hours/week:	03	Total teaching hours:		42
CIE: 50 marks	SEE: 50 marks	SEE: 03 hours		
Prerequisite: Industrial management				

Course Objectives:
After studying this course, students will be able to acquaint themselves with latest technological advances in the field of manufacturing and also enhance their knowledge in the field of management of technologies.

Modules	Teaching hours
Module I **Re-engineering**: Definition, importance of 3c's- customer, competition, and change. Fundamental rethinking, radical redesign and dramatic improvement. Role of IT., Case Studies **Benchmarking:** Definition, objectives of benchmarking, managing benchmarking process, concept of step zero, priorities of benchmarking, investigation, documentation, performance measures and improving process. Case Studies**.**	10
Module II **Six sigma**: Basics, core six sigma (DMAIC), design of six sigma, DFSS and customer, quality time and bottom line, core of DFSS–IDOV method, DFSS metrics, DFSS infrastructure – People and resources, implementing DFSS. Case Studies	8
Module III **Total Productive Maintenance (TPM):** Philosophy of TPM, Promoting, Training in TPM Philosophy, Improvement needs, goals and developing plans, Autonomous work groups. Case Studies	8

	Module IV	
	Activity Based Manufacturing: Introduction, traditional cost system, Activity based Management, implementation. Case Studies	**8**

	Module V	
	Agile Manufacturing : Introduction, exposure to basic concepts, Case Studies	**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 Hammer and Champy" Re-engineering the corporation" Nicholas Brearly pub. London
- Champ, Robert C " Bussiness process Benchmarking" Vision Books, New Delhi.
- Sahay B S and Sexena "World class Manufacturing" MacMillan India.
- Greg Brue "Six Sigma for Engineers" TMH

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

Course Code	CO #	Course Outcome (CO)
21IP834	**CO1**	Acquainted with re-engineering and explore the importance the of C's- Customer, Competition and Change
	CO2	set, investigate and document the benchmarking for manufacturing improvement process
	CO3	analyze for six sigma and implement it in manufacturing process
	CO4	set the goals and development plans after learning Total Product Maintenance (TPM)
	CO5	Exposed to basic concepts of activity based manufacturing and agile manufacturing. Able to conduct some case studies

Course title: Strategic Management			
Course code:	19IP832	Credits:	03
Teaching hours/week:	03	Total teaching hours:	42
CIE: 50 marks	SEE: 50 marks	SEE: 3 hours	

Course Objectives:

To develop the strategic thinking and decision making abilities of students, especially in relation to understanding the employability of various strategies in different situations.

Modules	Teaching hours
Module I **Strategic Management** - An Introduction - Evolution of business policy as a discipline - Concept of strategic management - Characteristics of strategic management - Defining strategy. **Strategy formulation** - Stakeholders in business - Vision, mission and purpose - Business definition, objectives and goals - Environmental appraisal - Types of strategies - Guidelines for crafting successful business strategies.	**9**
Module II Tailoring strategy to fit specific industry like Emerging industries, Market leaders, runner-up firms, etc **Strategic analysis and choice** - Environmental Threat and Opportunity Profile (ETOP) - Organizational Capability Profile - Strategic Advantage Profile - Corporate Portfolio Analysis - SWOT Analysis - Synergy and Dysergy - GAP Analysis - Porter's Five Forces Model of competition - Mc Kinsey's 7s Framework - GE 9 Cell Model.	**9**
Module III **Strategy implementation** - Issues in implementation - Project implementation - Procedural implementation - Resource Allocation - Budgets - Organization Structure - Matching structure and strategy - Behavioural issues - Leadership style - Corporate culture - Values - Power - Social responsibilities - Ethics - Building a capable organization -	**10**

Functional issues - Functional plans and policies - Financial, Marketing, Operations and Personnel plans and policies– Distinctive competitiveness Selection of matrix		
Module IV **Strategy Evaluation** - Importance - Symptoms of malfunctioning of strategy - Organization anarchies - Operations Control and Strategic Control - Measurement of performance - Analyzing variances - Role of organization	**7**	
Module V **New Business Models and strategies for Internet Economy** - Shaping characteristics of E-Commerce environment - E-Commerce Business Model and Strategies - Internet Strategies for Traditional Business - Key success factors in E-Commerce, systems in evaluation. **Cases in strategic management**. Cases encompassing the above topics to be analyzed and discussed in the class.	**7**	

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. Business Policy, 2nd Ed. - AzharKazmi
2. Strategic Management, 12th Ed. - Concepts and Cases - Arthur A. Thompson Jr. and A.J.Strickland
3. Management Policy and Strategic Management (Concepts, Skills and Practices) - R.M.Shrivastava
4. Business Policy and Strategic Management - P.Subba Rao
5. Crafting the strategy – concepts and cases in strategic management , Ranjan Das, TMH 2004

Reference Books:
1. RobertA Pitts & David Lei -Strategic Management, 4th Ed., Cengage Learning, 2006.
2. R Srinivasan - Strategic Management - The Indian Context, 3rd Ed.,PHI, 2008.
3. Thomas L. Wheelen& J. David Hunger- Concepts in Strategic Management & Business Policy, 12th edition, Pearson

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

Course Code	CO #	Course Outcome (CO)
21IP84OE	**CO1**	Identify the basic activities and understand the importance of strategic management
	CO2	Describe the knowledge and abilities in formulating strategies and plans
	CO3	Analyze the competitive situation and business environment in terms of changing market trends and technological advancements, and classify various strategies.
	CO4	Evaluate the challenges faced by managers in implementing and evaluating strategies based on the nature of business, industry and cultural differences
	CO5	Describe the new business model in the changed economy and apply these to formulate strategies for the changed economies

Course title: SEMINAR			
Course code:	**19IP85**	Credits:	1
Teaching hours/week:	02	Total teaching hours:	14
CIE: 50 marks	SEE: 50 marks	SEE: 30 Min	
Prerequisite:			

Course Objectives:
The seminar topic shall be selected from the emerging areas, preferably related to the branch of study. Individual students can choose the topics and then prepare the report and present it under the guidance of a faculty appointed by the head.

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

Course Code	CO #	Course Outcome (CO)
21IP85	**CO1**	Identify significant and latest topic of related UG program focusing on industrial and societal issues.
	CO2	Carry outnecessary survey for collection of information on specific topic selected for seminar.
	CO3	Perform self study on selected topic and carry outcritical analysis.
	CO4	Compile and make a technical report.
	CO5	Present the seminar topic systematically.

Course title: Project Phase-II				
Course code:	**19IP86**		Credits:	17
Contact hours/week:	08		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)
21IP86	**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:	**18IP87**	Credits:	01
Teaching hours/week:	-	Total teaching hours:	-
CIE: -	SEE: -	SEE: -	

Course Objectives:
Students to register for MOOCs like NPTEL, SWAYAM etc of their interest which will cont 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: Engineering Economics			
Course code:	19IP751	Credits:	03
Teaching hours/week:	3 (Theory)	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	7

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.		

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)
	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
18IP55	**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