PG-Curriculum
(Structure and Course Contents)
Production & Industrial Engineering

With effect from July 2018

EXPLORE INNOVATE EXCEL

Production & Industrial Engineering
Punjab Engineering College

(Deemed to be University)

Chandigarh

PG Curriculum Structure

Semester I

Sr. No.	Course Stream	Course Name	Credits	Segment {Fractal system (each section of 0.5 Credits and 7 contact hours)}					
				1	2	3	4	5	6
1.	Soft Computing	Internet of Things	1.5						
		Machine Learning	1.5						
2.	Soft Skills and Management	Communication Skills	1.5						
		Management Entrepreneurship and IPR	1						
		Professional Ethics	0.5						
3.	Program Core-I	Design of mechanical assemblies	3						
4.	Program Core-II	Computer aided Manufacturing	3						
5.	Program Elective-I: E1	• Advanced Manufacturing Processes • Advance Foundry Technology • Statistical Process Control • Lean Manufacturing	1.5						
	Program Elective-II: E2	• Additive Manufacturing Processes • Advance Casting Processes • Supply Chain management • Reliability Engineering	1.5						
6.	Engineering Mathematics (EM)	EM1: Statistical Techniques	1						
		EM2: Numerical Methods	1						
		EM3: Optimization Techniques and Genetic Algorithms	1						
		Total Credits	**18**						

Semester II

Sr. No.	Course Stream	Course Name	Credits	Segment {Fractal system (each section of 0.5 Credits and 7 contact hours)}					
				1	2	3	4	5	6
1.	Design of experiments and research methodology	Design of experiments and research methodology	3						
2.	Program Core -III	Finite Element Analysis	3						
3.	Program Core-IV	Welding Engineering	3						
4.	Program Elective-III: E3	• Robot Mechanics • Ergonomics • Production management System • Material, Manufacturing and Design	1.5						
	Program Elective-IV: E4	• Industrial Robotics • Applied Ergonomics • Operation management system • Plastic Processing Technology	1.5						
5.	Open Elective	• Value Engineering	1.5						
		• Productivity Engineering and Management	1.5						
6.	Mini project/ Pre-dissertation		3						
		Total Credits	**18**						

Summer Term *

Sr. no.	Course Code	Course Name	Credits
1		Industrial Visit(3 days to 1 week of visit, Submission and presentation of visit report)	Satisfactory/ Non-satisfactory

*After Examination of second semester, in the first week of summer vacation industry visit can be undertaken.

Course No.	Course Name	Credits	When it runs in a semester					
			1	2	3	4	5	6
Semester-III								
1.	Dissertation/Industry Project	14						

Course No.	Course Name	Credits	When it runs in a semester					
			1	2	3	4	5	6
Semester-IV								
1.	Dissertation/Industry Project	18						

Total Credits- 68

- ***20% courses/ semester can be offered in blended mode MOOC's/Industry.***
- ***MOOC's/Industry offered course is having fractional credits. Industry offering course content will be designed by industry will be as per expert availability. Industry person will deliver and evaluate this subject. As per the duration of MOOC's/industry offered course, credits of this course can be decided (fractional credits).***

SEMESTER – I

SOFT COMPUTING

Course Name	**:**	**Internet of Things**
Course Code	**:**	**SCM5011**
Credits	**:**	**1.5**
L T P	**:**	**2 0 2**
Segment	**:**	**1-3**

Total No. Lectures: 14
Total No. of Lab hrs. 14

Course Objectives:

The main objectives of this course are:	
1.	Understanding of core technology, applications, sensors used and IOT architecture along with the industry perspective.
2.	Principles and operations of different types of sensors commonly used on mobile platform will be taught in a manner that by the end of the course the students will be able to design and implement real time solutions using IOT.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction to IOT** What is IoT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market , Privacy issues in IOT	2
2.	**Setting Up Raspberry Pi/Arduino to Create Solutions** Explore Raspberry Pi, Setting up Raspberry Pi, Showing working of Raspberry Pi using SSH Client and Team Viewer, Understand Sensing actions, Understand Actuators and MEMS.	3
3.	**Communication Protocols used in IoT** Types of wireless communication, Major wireless Short-range communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN)	3
4.	**IoT Applications** IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications	3
5.	**Sensors** Applications of various sensors: Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras Global positioning sensors: GPS, GLONASS, IRNSS, Galileo and indoor localization systems, Motion & Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope, Calibration, - noise modelling and characterization, and - noise filtering and sensor data processing, Privacy & Security, Selection of Sensors for Practical Applications	3

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Setting up Raspberry Pi and Arduino	2
2.	Build small scale wireless communicating IOT device	4
3.	Integrate positioning sensors to IOT device	4
4.	Integrate motion and orientation sensors to IOT device	4

Course Outcomes:

At the end of the course, students will be able to:	
1.	Understand the concept of IOT
2.	Study IOT architecture and applications in various fields
3.	Study the security and privacy issues in IOT.
4.	Understand various applications of sensor in Industrial, healthcare, commercial, and building automation.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", VPT, 1st Edition	2014
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition	2013
3.	CunoPfister, "Getting Started with the Internet of Things", OReilly Media	2011
4.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing	2015

Course Name	**:**	**Machine Learning**
Course Code	**:**	**SCM5012**
Credits	**:**	**1.5**
L T P	**:**	**2 0 2**
Segment	**:**	**4-6**

Total No. Lectures: 14
Total No. of Lab hrs. 14

Course Objectives:

The main objectives of this course are:	
1.	To formulate machine learning problems corresponding to different applications.
2.	To understand a range of machine learning algorithms along with their strengths and weaknesses.
3.	To develop reasoning behind Model selection, model complexity, etc.

Course Contents:

Sr. No.	Course Contents	No. of Lectures
1	**BASICS OF MACHINE LEARNING:** Applications of Machine Learning, processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Real life examples of Machine Learning.	3
2	**SUPERVISED LEARNING:** Classification and Regression: K-Nearest Neighbour, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Evaluation Measures: SSE, MME, R2, confusion matrix, precision, recall, F-Score, ROC-Curve.	6
3	**UNSUPERVISED LEARNING:** Introductiontoclustering,TypesofClustering:Hierarchical-AgglomerativeClustering and Divisive clustering; Partitional Clustering - K-means clustering, Principal Component Analysis,ICA.	5

Lab Work:

Sr. No.	Lab Contents	No. of hours
1.	Python Introduction: Loops and Conditions and other preliminary stuff, Functions, Classes and Modules, Exceptions, Database access, Mathematical computing with Python packages like: numpy, Mat- plotLib, pandas Tensor Flow, Keras	8
2.	Application Oriented Project Work	6

Course Outcomes:

At the completion of this course, students will be able to:	
1.	Design and implement machine learning solutions to classification, regression and clustering problems
2.	Evaluate and interpret the results of the different ML techniques
3.	Design and implement various machine learning algorithms in a range of Real-world applications.
4.	Use Python for various applications.

Bibliography:

Sr. No.	Book Detail	Year of Publishing
1.	Tom Mitchell, Machine Learning, McGraw Hill,	2017
2.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer,	2011.
3.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,	2008.
4.	Yuxi (Hayden) Liu, "Python Machine Learning By Example", Packet Publishing Limited	2017

SOFT SKILLS
&
MANAGEMENT

Course Name	**:**	**Communication Skills**
Course Code	**:**	**SSM5021**
Credits	**:**	**1.5**
L T P	**:**	**0-1-4**
Segment	**:**	**1-3**

Total no. of Tutorials: 07
Total no. of lab hours: 28

Course Objectives:

The main objectives of this course are:	
1.	To enhance competence in communication skills: verbal and nonverbal.
2.	To provide orientation in technical communication skills: spoken and written.
3.	To sensitize students to attitude formation and behavioural skills.

Course Contents:

Sr. No.	**Course contents**	**No. of Tutorials**
1.	**Introduction to Communication Skills, Soft Skills and Interpersonal Communication**	1
2.	**Speech:** Structure, Elements, Content, Organization and Delivery J-a-M	1
3.	**Writing Skills:** Letters, Minutes of Meeting	1
4.	**Technical Report Writing:** Concept & Structure	1
5.	**Research Writing:** Concept & Structural Framework	1
6.	**Power Point Presentation:** Project Presentation	1
7.	**Interviews**	1

Lab Work:

Sr. No.	**Lab contents**	**No. of Hours**
1.	Self- Introduction	2
2.	Negotiation Skills & Role Play	2
3.	J-a-M Session	2
4.	Building Word Power through Reading	2
5.	Group Discussion and Case Study	4
6.	Writing Skills: Letters, Minutes of Meeting	2
7.	Technical Report Writing: Concept & Structure	4
8.	Research Writing: Concept & Structural Framework	4
9.	Power Point Presentation: Project Presentation	4
10.	Interviews	2

Course Outcomes:

At the completion of this course, students will be able to:	
1.	Show enhanced competence in communication skills and technical communication.
2.	Develop awareness of attitude formation and behavioural appropriateness
3.	Gain self-confidence and perform better in their academic and professional life.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Technical Communication, Meenakshi Raman and Sangeeta Sharma, Oxford University Press	2015
2.	English for Research Paper Writing, Adrian Wallwork, Springer, London	2011
3.	English Vocabulary In Use: Advanced+ CD, McCarthy Michael, CUP, Cambridge	2004
4.	Advanced English Grammar, Martin Hewings, CUP, Cambridge	2003
5.	Study Listening, Lynch Tony, CUP, Cambridge	2004
6.	Study Speaking , Anderson Kenneth, CUP, Cambridge	2010
7.	Study Reading , Glendenning H. Eric, CUP, Cambridge	2004
8.	Study Writing , Lyons Liz Hamp & Ben Heasley, CUP, Cambridge	2004
9.	Study skills in English, Michael J. Wallace, CUP, Cambridge	2004

MOOCs on this course are available at:

1) "Take Your English Communication Skills to the Next Level". Available at Coursera (Offered by Georgia Institute of Technology), 4 weeks, Starts on September 10, 2018.

https://www.coursera.org/learn/english-communication-capstone

2) "Effective Communication in Globalised Workplace- The Capstone". Available at Coursera (Offered by National University of Singapore), 3 weeks, Starts on August 06, 2018.

https://www.coursera.org/specializations/effective-communication

Course Name	**:**	**Management Entrepreneurship and IPR**
Course Code	**:**	**SSM5022**
Credits	**:**	**1**
L T P	**:**	**0-3-0**
Segment	**:**	**4-5**

Total No. Tutorials: 14

Course Objectives:

The main objectives of this course are:	
1.	To make students familiar with the concepts of Management, Entrepreneurship and Intellectual Property Rights (IPRs).
2.	To make students understand how to initiate a new Start-up and manage it effectively.
3.	To enable students to convert their innovative ideas into different forms of IPRs.

Course Contents:

Sr. No.	Course contents	No. of Tutorials
1.	**Introduction to Management:** Concepts and Principles of Management	**1**
2.	**Functions of Management:** Planning Process - Hypothetical Planning of an Event/Activity, Form of Organization Structure - Case Study, Human Resource Planning and Process, Elements of Directing and Effective Control Mechanism, Activity: Role Playing/Management Game	**4**
3.	**Introduction to Entrepreneurship:** Concepts of Entrepreneurship and Characteristics of Entrepreneurs	**1**
4.	**Development Phases of Entrepreneurship:** Innovation and Idea Generation, Project Formulation and Validation (Feasibility Analysis), Business plan	**2**
5.	**Ecosystem for Entrepreneurship Development:** Government Schemes and Initiatives, Financial and Non-Financial Institutional Support, Legal Framework, Role of Incubator, Venture Capitalist, Angel Investor, Crowd Funding Accelerator etc.	**2**
6.	**Intellectual Property Rights (IPRs):** Concept and Relevance of IPRs, Process for filing IPR	**2**
7.	**Different Forms of IPRs:** Patents, Copyright, Trademarks, Industrial Designs and Geographic Indicator	**2**

Course Outcomes:

At the completion of this course, students will be able:	
1.	To develop and manage new project/Start-up.
2.	To apply managerial skills for success of entrepreneurial/business venture.
3.	To make effective use of IPR practices in their ventures.

Bibliography:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	"Management Principles and Practice", Srinivasan R. and Chunawalla S.A., Himalaya Publishing House.	**2017**
2.	"Introduction to Management", Schermerhorn John R. Jr. And Bachrach Daniel G., 13th Edition, Wiley Publications	**2016**
3.	"Principles & Practice of Management", Prasad L.M., 8th Edition, Sultan Chand & Sons.	**2015**
4.	"The New Era of Management", Daft R.L., 11th Edition, Pubs: Cengage Learning.	**2014**
5.	"Case Studies in Management", Pandey Chandra Akhilesh, 2nd Edition, I.K. International Publishing House Pvt. Ltd.	**2015**
6.	"Harvard Business Review: Manager"s Handbook", Harvard Business School Press.	**2018**
7.	"Entrepreneurship", Trehan Alpana, Dreamtech Press.	**2016**
8.	"Entrepreneurship and Small Business" Schaper Michael, Volery Thierry, Weber Paull and Lewis Kate, 3rd Asia-Pacific Edition, Wiley Publications	**2018**
9.	"Harvard Business Review: Entrepreneur"s Handbook", 1st Edition, Harvard Business Review Press	**2018**
10.	"Take Me Home", Bansal Rashmi, 1st Edition, Westland.	**2014**
11.	"Intellectual Property Law", Narayanan P., 3rd Edition, Eastern Law House	**2017**
12.	"Intellectual Property Rights", Pandey Neeraj and Dharni Khushdeep, PHI Learning	**2014**
13.	"Intellectual Property Rights", Rosedar S.R.A., LexisNexis (Quick Reference Guide – Q&A Series)	**2016**
14.	MSME Annual Publications (www.msme.gov.in)	**Annual**
15.	WIPO Annual Publications (www.wipo.int)	**Annual**

MOOCs on this course are available at:

1) "Entrepreneurship: Do Your Venture", Available at edx (Offered by IIM Bangalore), Self-Paced (6 weeks).
   https://www.edx.org/course/entrepreneurship-do-your-venture
2) "Becoming an Entrepreneur", Available at edx (Offered by MIT), Self-Paced (6 weeks).
   https://www.edx.org/course/becoming-entrepreneur-mitx-launch-x-4
3) "How to Build a Start-up", Available at Udacity, Self-Paced (One Month).
   https://in.udacity.com/course/how-to-build-a-startup--ep245
4) "Intellectual Property Rights: A Management Perspective, Available at edx (Offered by IIM Bangalore), Starts on 1 August 2018 (6 weeks).

   https://www.edx.org/intellectual-property-rights-a-management-perspective

Course Name	**:**	**Professional Ethics**
Course Code	**:**	**SSM5023**
Credits	**:**	**0.5**
L T P	**:**	**0-3-0**
Segment	**:**	**6-6**

Total No. Tutorials: 07

Course Objectives:

The main objectives of this course are:	
1.	To imbibe ethical values and understanding.
2.	To develop moral thinking that will help students to recognize their potential.
3.	To engage and motivate the students to perform ethically in their professional life.

Course Contents:

Sr. No.	Course contents	No. of Tutorials
1.	**Introduction to Ethics:** Concept of Ethics – Nature, Scope, Sources, Types, Functions and Factors influencing Ethics, Ethics in Engineering	2
2.	**Ethics in Profession:** Concepts of Honesty, Integrity, Reliability, Risk, Safety and Liability, Responsibilities and Rights of Professionals, Professional accountability.	2
3.	**Ethics and Business:** Concept of Business Ethics – Nature and Objectives, Ethical dilemmas in business ethics.	1
4.	**Self-Development:** Concept of Self-Assessment – SWOT Analysis, Self-Concepts, Self-Confidence, Self-Esteem, Managing Time and Stress, Human values.	2

Course Outcomes:

At the completion of this course, students will be able to:	
1.	Demonstrate knowledge and better understanding of self and to manage time and stress effectively.
2.	Have subjective well-being.
3.	Have ethical decision making ability in their personal and professional life.

Bibliography:

Sr. No	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	"Professional Ethics", Subramaniam R., 2nd Edition, Oxford University Press.	2017
2.	"Introduction to Psychology", Kalat James W., 11th Edition, Cengage Learning.	2017
3.	"Business Ethics – Text and Cases", Murthy C.S.V., 1st Edition, Himalaya Publishing House.	2014

4.	"A Foundation Course in Human Values and Professional Ethics", Gaur R.R., Sangal R. and Bagaria G.P., Excel Books.	2010
5.	"Issues and Ethics in the Helping Professions", Corey G., Corey M.S. and Callanan P., 8th Edition, Brooks/Cole, Cengage Learning.	2010
6.	"The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Leary M.R., 1st Edition, Oxford University Press.	2007
7.	"Business Ethics", Hartman L.P. and Chatterjee A., 3rd Edition, Tata McGraw Hill.	2006
8.	"Business Ethics and Professional Values", Rao A.B., Excel Books.	2006
9.	"Business Ethics – Concepts and Cases", Velasquez M.G., 5th Edition, Prentice Hall.	2001
10.	"Theories of Personality", Hall C.S., Lindzey D. and Cambell J.B., 4th Edition, Hamilton Printing Company.	1997

PROGRAM CORE

Course Name	**:**	**Design of Mechanical Assemblies**
Course Code	**:**	**PRM5011**
Credits	**:**	**3**
L T P	**:**	**2-1-0**
Segment	**:**	**1-6**

Total No. Lectures: 42

Course Objectives:

The main objectives of this course are:	
1.	To understand product life cycle and the relevance of assemblies in this cycle.
2.	To understand design and manufacture of assemblies.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Product Requirements And Top-Down Design** Chain of delivery of quality, Key characteristics, Variation risk management, Examples, Key characteristics conflict, Assembly in the context of product development, Assembling a product, Present status of assembly.	3
2.	**Mathematical And Feature Models Of Assemblies** Types of assemblies: Distributive systems, Mechanism and structures, Types of assembly models, Matrix transformations: Nominal location transforms, Variation transforms, Assembly features and feature-based design, Mathematical models of assemblies, Examples of assembly models.	8
3.	**Constraint In Assembly** Kinematic design, Features as carriers of constraints, Use of screw theory to represent and analyze constraints, Design and analysis of assembly features using screw theory, Constraint analysis	6
4.	**Dimensioning And Tolerancing Parts And Assemblies** Dimensional accuracy in manufacturing, KCs and tolerance flow down from assemblies to parts, Geometrical dimensioning and tolerance, Statistical and worst-case tolerancing, Modelling and managing variation buildup in assemblies	7
5.	**Assembly Sequence Analysis** Assembly sequence design process, Bourjault method of generating feasible sequencies, Cutset method, Checking stability of sub-assemblies	6
6.	**Datum Flow Chain** DFC definition, Mates and contacts, KC conflict and its relation to assembly sequence and KC priorities, Assembly precedence constraints, DFCs, tolerances and constraints, Design procedure for assemblies	6
7.	**Design For Assembly And Design For Manufacturing** Sequential versus concurrent engineering, understanding interactions between design and manufacturing, benefits of concurrent engineering, concurrent engineering techniques, design for assembly, design for manufacturing	6

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to mathematically model a product and carry out constraint analysis and assembly sequence analysis.
2.	Students should be able to carry out tolerance analysis and synthesis.
3.	Students should be able to apply principles of DFM to consumer products.

Bibliography:

Sr. No.	**Book Detail**	**Year of Publication**
1.	Whitney D.E., Mechanical assemblies: Their design, manufacture and role in product development, Oxford University Press, 2004	2004
2.	Zeid Ibrahim, CAD/CAM Theory and Practice, Tata Mcgraw Hill, 2009	2009
3.	Singh Nanua, Systems Approach to Computer Integreted Design and Manufacturing, John Wiley & Sons, 1996.	1996
4.	GeofferyBoothroyd, Peter Dewhurst, Winston Knight, Product Design for Manufacturing and Assembly, Marcel Dekker , NewYork 2nd edition , 1994.	1994

Course Name	**:**	**Computer Aided Manufacturing**
Course Code	**:**	**PRM5021**
Credits	**:**	**3**
L T P	**:**	**2-0-2**
Segment	**:**	**1-6**

Total No. Lectures: 28
Total No. of Lab hrs: 28

Course Objectives:

The main objectives of this course are:	
1.	To provide knowledge and details of the means of computer aided manufacturing.
2.	To understand various functions supporting the automated manufacturing.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction** Basics and need of NC/CNC/DNC, applications and advantages of CNC machines and its role in FMS, classifications of CNC machines.	3
2.	**Constructional Details Of Cnc Machines** Machine structure, slide-ways, motion transmission elements, swarf removal and safety considerations, automatic tool changer, multiple pallet systems, feed-back devices, machine control unit, and interpolators.	5
3.	**CNC Part Programming** Introduction to Part Programming, Axis identification and coordinate systems, structure of CNC part program, programming formats, Radius and Length Compensation Schemes, Advanced Programming Features & Canned Cycles, Computer Aided CNC part programming using APT language.	5
4.	**Adaptive Control System** Adaptive control with Optimization, Adaptive control with Constraints, AC System for Turning and Grinding	5
5.	**Material Handling And Storage** Material transport systems- AGVs, conveyors, analysis of material transport systems. Storage system performance, automated storage systems, engineering analysis of storage systems.	5
6.	**Manufacturing Support Functions** Introduction to group technology (GT), computer aided process planning (CAPP), material requirement planning MRP (MRP), capacity planning, scheduling etc.	5

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	To learn and write part programming for given job.	28
2.	To perform simulation operations for drilling, milling etc on Master CAM software for givenjob.	
3.	To perform single point drilling operation on VMC machine using Master CAM software.	
4.	To perform multiple point drilling operation on VMC machine using Master CAM Software.	
5.	To perform contour milling operation on VMC machine using Master CAM Software.	
6.	To perform milling/ engraving operation on VMC machine using Master CAM Software.	
7.	To make a report on VMC learning and maintenance.	

Course Outcomes:

At the end of the course, students will be able to:	
1.	Student should be able to understand the how CNCs are different form conventional machine tools.
2.	Student should be able to learn part programming and working on the CNC machines.
3.	Student should be able to understand about applications of adaptive control.
4.	Student should have knowledge material handling devices, CAPP, MRP and other supporting functions.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Kundra T K, Rao P N, Tewari N K, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill, 2002.	2002
2.	Koren Y, Computer Control of Manufacturing Systems, McGraw-Hill, 1986	1986
3.	Pabla B.S & M Adithan, CNC machines, New Age Publishers, New Age International Pvt Ltd Publishers, 2009	2009
4.	Singh, N., "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996.	1996
5.	Chang, T.-C., Wysk, R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall, 2005	2005
6.	Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Prentice-hall Int, 2007.	2007
7.	Chua C K, Leong K F, Lim C S, Rapid Prototyping-Principles and Applications, World Scientific Publishing Co. Ltd, 2010.	2010

PROGRAM ELECTIVE

Course Name	**:**	**Advanced Manufacturing Processes**
Course Code	**:**	**PRM5101**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**1-3**

Total No. of Lectures: 14
Total No. of lab hrs: 14

Course Objectives:

The main objectives of this course are:	
1.	To describe and choose different advanced manufacturing processes.
2.	To understand how to enhance the manufacturability.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction** Evolution, need, types, classification and comparison between conventional and advanced (modern) manufacturing processes (AMP).	**2**
2.	**Mechanical Processes** Ultrasonic machining (USM), Rotary Ultra Sonic Machining (RUM), AJM, WJM, AWJM processes, AFM, Magnetic Abrasive and Magneto Rheological processes. Principle and mechanism of material removal; process parameters; Applications, Characteristics, advantages and limitations.	**3**
3.	**Chemical and Electro Chemical Processes:** Chemical Machining, Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes, Principle of Electro chemical machining, process, mechanism of material removal, process parameters, applications and limitations.	**3**
4.	**Thermal Processes:** EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal, Heat Affected zone, Electrode materials and tooling, Process parameters and characteristics; Surface finish and accuracy, Process Capabilities; Applications; Limitations.	**3**
5.	**Derived And Hybrid Processes:** Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM), Electro Chemical Honing (ECH), Electro Chemical Deburring (ECDE), Electro Chemical Discharge Machining (ECDM) - Process Parameters, Applications and Limitations.	**3**

Sr. No.	Lab Content	No of Hrs
1	Exercise on EDM machine	**4**
2	Exercise on tooling and AFM Machine	**3**
3	Exercise on Hybrid process like ECDM/ ECH/ WECDM	**4**
4	Exercise on development of tooling for EDM/ AFM/ USM processes	**3**

Lab Work:

Course Outcomes:

At the end of the course,	
1.	Student should be able to apply different advanced manufacturing processes and discuss the effects of the Advance Manufacturing technologies.
2.	Students should be able to select cost effective manufacturing process for domestic and industrial applications.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Micro Machining by VK Jain, Narosa Publishers, 2018.	2018
2.	Advanced Machining Processes, Hassan Abdel-Gawad El-Hofy, Mc Graw Hill, 2005	2005
3.	Advanced machining Processes, VK Jain, Inderscience Enterprises, 2011	2011
4.	"New Technology"ABhattacharaya, Institution of Engineers, India, 2000.	2000

Course Name	**:**	**Advance Foundry Technology**
Course Code	**:**	**PRM5102**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**1-3**

Total No. of Lectures: 14
Total No. of Lab hrs: 14

Course Objectives:

The main objectives of this course are:	
1.	To understand about the safety, various moulding sand ingredients and their properties.
2.	Design of gating and risering for various metals used in the casting.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction** Safety aspects, pollution control considerations, automation in foundry, fluidity testing, metallurgical consideration of cast iron, SG iron, aluminium and steel for casting. Ferrous and non-ferrous materials and their properties, types of sand, sand properties, testing and control, special sand additives, metallurgical consideration of cast iron, SG iron, steel and aluminium for casting process.	4
2.	**Sand Control** Types of sand, significance, ingredients of the moulding sand, measurement and control of AFS no permeability, moisture and green strength on the shop floor. Effect of dextrin, iron oxide coal dust etc. on the soundness of the casting	4
3.	**Solidification Of Casting** Nucleation and growth, segregation, progressive and directional solidification, relationship between solidification time and modulus of the casting.	3
4.	**Methoding** Applications of CAD/ CAM in foundry, pattern design , use of additive manufacturing in pattern making, casting design considerations, design of gating system for ferrous and non-ferrous materials, effect of gate design on aspiration , turbulence and dross entrapment. Different methods of riser design, different methods for improvement of yield of casting. Riser design for gear blank, valve and slab.	3

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Prepare a standard sand sample by using different sand ingredients and analyse the effects of ingredients by developing a mathematical model.	14
2.	Design and fabricate a pattern of the given job; Design the gating and risering system for a given job	

Course Outcomes:

At the end of the course, students will be able to:	
1.	Select the appropriate sands, its properties.
2.	Select the ingredients of the sands
3.	Test the sand
4.	Design the pattern
5.	Design gating and risering of the given casting

Bibliography:

Sr. No.	**Book Detail**	**Year of Publication**
1.	Principles of metal casting. Heine and Rosenthal , Tata McGraw Hill , 2011.	2011
2.	Metal Casting, P.L Jain, Tata McGraw Hill,2013.	2013
3.	ASM handbook ,Vol. 15 Casting, ASM Publication, 1998	1998

Course Name	**:**	**Statistical Process Control**
Course Code	**:**	**PRM5103**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**1-3**

Total No. of Lectures-14
Total No. of Lab hrs – 14

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of variation and its impact on competitiveness
2.	To develop competence in computing process capability
3.	To develop competence in constructing control charts

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction**: Quality control, application of statistics in quality control: Statistical Process Control, Acceptance sampling Concept of variation, cause of variation: Common Cause & Special Cause of variation, Natural control limits of process, stable v/s capable process, Impact of variability in competitive environment, Loss function: traditional loss function, Taguchi‟s loss function	5
2.	**Process Capability Analysis, Process capability indices:** Cp, Cpk, Cpm Process performance analysis from short pre- production; Pp, Ppk Process capability for attribute data; DPU (defects per unit), DPMO (defects per million opportunity, RTY (Rolled throughput yield)	4
3.	**Control Charts for Variables** - X Bar-R Charts, X Bar-s Charts, Individual Moving Range (IMR) Charts, Exponentially Weighted Moving Average (EWMA) Control charts and Control Charts for Attributes - p-Charts, np-Charts, c-Charts, u-Charts	5

Lab Work:

Sr. No.	Lab Contents	No. of Hours
Application of following tools in real life scenario by selecting a process/machine from the institute or in industry		
1.	Process capability from pre-production run	2
2.	X-bar –R control chart	4
3.	Process capability Analysis from control chart	2
4.	P-chart/NP-chart	3
5.	C-chart/U-chart	3

Course Outcomes:

After successful completion of the course, students will be able to	
1.	Evaluate process capability from pre-production run as well as from a stable process
2.	Compute DPMO and RTY for processes generating discrete quality data.
3.	Draw and interpret control charts for variable as well as attribute data for different types of manufacturing processes and service activities.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Statistical Quality Control by Eugene L. Grant, McGraw-Hill Series in Industrial Engineering and Management	2017
2.	Introduction to Statistical Quality Control by Douglas C. Montgomery, John Wiley & Sons	2016
3.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
4.	Automotive Industry Action Group (AIAG) manual of Statistical Process Control	2005

Course Name	**:**	**Lean Manufacturing**
Course Code	**:**	**PRM5104**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**1-3**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1	To understand the concept of non-value added activities
2	To develop competency for identifying wastes in the processes.
3	To develop competency to use lean concepts and tools in reducing waste and managing flow of product
4	To introduce Total Productive Maintenance (TPM) for improving operational efficiencies

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	Introduction to Lean Manufacturing: Basic concept of Lean, overview of Toyota Production System, Pillars of Lean House- JIKODA, JIT, Concept of value added and non-value added activities, Concept of 3Ms: Muri-Mura-Muda, Seven Wastes, Waste elimination: need and methods	3
2.	Implementation of Lean methodology – Cultural change, Pitfalls, Building base for Lean: 5S & Visual management, Working on JIDOKA pillar (Poke yoke, Andon, 5 Why, Gemba Kaizen, CIP)	6
3.	Working on JIT Pillar (Tact time, Balanced operation, Push- Pull system, Minimum lot size, SMED/ OTS, Standardization), Heijunka Production control tools – Scheduling, Buffer stock, KANBAN	6
4.	Total Productive Maintenance- concept and advantages, Goals of TPM, Seven Pillars of TPM, Type of Losses, Type of Abnormalities, 0- 7JH steps, OPL, Why- Why analysis, Calculations of OEE	6

Course Outcomes:

At the end of the course, students will be able to:	
1.	Student should be able to learn about lean manufacturing and its applications in industries.
2.	Student should be able to understand methodology in lean manufacturing**.**

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Liker, Jeffrey K. and Meier, David P. (2007); The Toyota Way Fieldbook; Tata McGraw-Hill	2007
2.	Liker, Jeffrey K. (2004); The Toyota Way; Tata McGraw-Hill.	2004
3.	TPM Development Programme : Nikajima, Productivity Press Cambridge,2006.	2006

Course Name	**:**	**Additive Manufacturing Processes**
Course Code	**:**	**PRM5201**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**4-6**

Total No. of Lectures: 14
Total No. of Lab hrs: 14

Course Objectives:

	The main objectives of this course are:
1.	To demonstrate comprehensive knowledge of the broad range of Additive manufacturing processes.
2.	To develop physical objects that meets prototyping requirements, using additive manufacturing devices and processes.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Additive Manufacturing Technologies** Introduction to Additive manufacturing, principles, applications and limitations.	**4**
2.	**Techniques In Additive Manufacturing** Stereo-lithography, Selective laser sintering, Fused deposition modelling, Three-dimensional printing, Laminated Object Manufacturing	**4**
3.	**Additive Manufacturing Applications** Factors influencing accuracy, Rapid Tooling, Advantages, limitations and applications.	**3**
4.	**Case Studies And Software Used In RP/ RM** Case studies on Product, material and optimization, Software used, STL files, Internet based and collaboration tools.	**3**

Lab work

Sr. No.	**Lab Content**	**No. Lab hrs**
1.	Exercise on selection of process parameters and programming on RPT	**5**
2.	Exercise on FDM/ 3-D printing for a given model/ specimen.	**5**
3.	Exercise on testing and evaluation of the prepared model/ specimen	**4**

Course Outcomes:

At the end of the course,	
1.	Student should be able to design, engineer and fabricate an actual multi-component object using additive manufacturing processes.
2.	Student should be able analyze the characteristics of the different materials in Additive Manufacturing.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	"Rapid Prototyping: Principles and Applications in Manufacturing" Chua, C.K., and Leong, L.F., John Wiley & Sons Ltd. L.F., John Wiley & Sons Ltd.	2014
2.	Gibson, I, Rosen, D W., and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010	2010
3.	"New Technology" A. Bhattacharaya, Institution of Engineers, India	2000

Course Name	**:**	**Advance Casting Processes**
Course Code	**:**	**PRM5202**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**4-6**

Total No. of Lectures: 14
Total No. of Lab hrs. 14

Course Objectives:

The main objectives of this course are:	
1.	To gain knowledge about operating procedures, applications, advantages and inspection of various casting processes.
2.	Appropriate knowledge about causes and remedies of casting defects and their inspection.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Moulding And Casting Processes** Machine, shell, investment, vacuum, full mould, CO2, injection, die and centrifugal casting processes, magnetic moulding process, hot box and cold box moulding squeeze and press casting, Shaw process, Anitoch process	5
2.	**Internal Stresses and Defects** Residual stresses, hot cracks, stress relief, defects and their causes and remedies, gasses in metal-method of elimination and control of dissolved gases in casting	5
3.	**Testing, Inspection And Quality Control** X-ray and gamma ray radiography, magnetic particle, die penetrant and ultrasonic inspection, use of statistical quality control in foundry. ASME code for inspection of casting.	4

Lab Work:

Sr. No.	**Lab contents**	**No. of Hours**
1.	To prepare a mould for a given pattern and characterize the mould. To cast the job by pouring the metal in the given mould and clean the casting.	14
2.	To inspect the casting and prepare the inspection reports. Subsequently, suggest the remedial measure to improve the quality of the casting.	

Course Outcomes:

At the end of the course, students will be able to:	
1.	Select the moulding process and prepare the mould for a given job.
2.	Select the heat treatment cycle for a given casting product
3.	Inspect the given casting

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Principles of metal casting. Heine and Rosenthal, Tata McGraw Hill, 2011.	2011
2.	Metal Casting, P.L Jain, Tata McGraw Hill, 2013.	2013
3.	ASM handbook, Vol. 15 Casting, ASM Publication, 1998.	1998

Course Name	**:**	**Supply Chain Management**
Course Code	**:**	**PRM5203**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**4-6**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To provide introduction to supply chain management, foundation for design and analysis of supply chain network.
2.	To provide an insight into functioning and networking of supply chain decisions for the success of a business.
3.	To frame a sound supply chain network in the country.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction** Understanding supply chain, supply chain performance; supply chain drivers and obstacles.	5
2.	**Planning In A Supply Chain** Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand, Economic Order Quantity Models, Reorder Point Models, Inventory Systems.	4
3.	**Planning And Managing Inventories In A Supply Chain** Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.	4
4.	**Modern Supply Chain Management** Reverse supply chain strategies, Green supply chain management, Sustainable practices in Supply chain, Case studies and examples.	4
5.	**Coordination In Supply Chain** Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.	4

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students will be able to learn major building blocks, major functions, major business processes and major decisions in supply chain networks.
2.	Summarize the foundation for design and analysis of supply chain management.
3.	Apply specialized concepts, principles and models for operational and strategic improvement in supply chain management.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Handfield R.B. and Nichols E.L., Jr., "Introduction to Supply Chain Management", Prentice-Hall Inc, 2000.	2000
2.	Sunil Chopra And Peter Meindl, "Supply Chain Management , strategy, planning, and operation"6/e –PHI, second edition, 2014.	2014
3.	V.V.Sople, "Supply Chain Management, text and cases", Pearson Education South Asia,2012.	2012
4.	Balkan Cetinkaya, Richard Cuthbertson, Graham Ewer,"Sustainable Supply Chain Management: Practical ideas for moving towards best practice", Springer, 2011.	2011
5.	Arnold J. R. T. and Chapman S. N., "Introduction to Materials Management", 4th Edition, Pearson Education Asia, 2001.	2001

Course Name	**:**	**Reliability Engineering**
Course Code	**:**	**PRM5204**
Credits	**:**	**1.5**
L T P	**:**	**2-1-0**
Segment	**:**	**4-6**

Total No. of Lectures -14
Total No. of Tutorials - 07

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the relationship between reliability, maintainability and availability of a system.
2	To provide knowledge of constant failure rate models and time dependent failure models
3	To enhance competency in assessment of system reliability and design for reliability
4	To give the appreciation level knowledge of various reliability testing methods

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	Introduction to reliability engineering, Relationship between reliability, maintainability and availability, Availability – Operational, Inherent and Achieved; MTBF and MTTR Trade off, MTTR Prediction	3
2.	Failure distribution, Reliability function – Mean time to failure – Hazard rate function – Bathtub curve – Life Testing and Reliability, Failure Terminated Tests, Time Terminated Tests, Sequential Reliability Testing, Constant failure rate models (Exponential reliability function), Two-parameter exponential distribution model, Time dependent failure models: Weibull distribution – Normal distribution – Lognormal distribution	4
3.	System reliability: Basics of redundancy – Standby redundancy systems, Use of reliability block diagrams, System with components in series, System with components in parallel, mixed system, k-out-of-n redundancy, Fault tree construction and analysis, Design for reliability: Basic parameters, reliability allocation, Redundancy, Failure analysis	4
4.	Reliability life testing, Types of reliability tests, Accelerated life testing (ALT) highly accelerated life testing (HALT) Reliability enhancement testing (RET), Environmental stress screening (ESS), Burn-in testing, Life testing plans for reliability	3

Tutorials	**No. of Hours**
Case Studies:- • Application of MTBF & MTTR in maintenance of machines • Application of Fault tree in reliability assessment • Reliability enhancement techniques	7

Course Outcomes:

After successful completion of the course, students will be able to	
1.	Compute MTBF and MTTR
2.	Do reliability testing and assessment for constant failure rate models and time dependent failure rate models
3.	Assess & predict system reliability
4.	Select pertinent reliability test

Bibliography:

Sr. No.	**Book Detail**	**Year of Publication**
1.	An Introduction to Reliability and Maintainability Engineering by Charles E.Ebeling, Tata McGraw-Hill	2000
2.	Life Cycle Reliability Engineering by Guangbin Yang Ford Motor Company, John Wiley & Sons	2007
3.	An introduction to reliability engineering by L. Shrinath	2005
4.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
5.	Probability and statistics for Engineers, by I. R. Miller, J. E. Freund & R. Johnson, Prentice Hall of India	2001
6	Handbook of Reliability Engineering, HoangPham (Editor), Springer	2003

ENGINEERING MATHEMATICS

Course Name	**:**	**Statistical Techniques**
Course Code	**:**	**EMM5018**
Credits	**:**	**01**
L T P	**:**	**2-0-2**
Segment	**:**	**1-2**

Total No. of Lectures– 10
Total No. of Lab hrs -10

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the concepts of random variable and probability distributions.
2	To make the students able to solve problems on Binomial, Poisson and Normal distributions, sampling distributions and hypothesis testing.

Course contents:

Sr. No.	Course Contents	No. of Lectures
1	Random Variable, Discrete and continuous probability distributions, mean, variance, joint probability distribution, covariance, Binomial, Poisson and Normal distributions	06
2	Sample, Sampling distributions, Central Limit Theorem, Hypothesis Testing	04

Lab Work:

Sr. No.	Lab. Contents	No. of Hours
1.	Use of statistical functions of MS Excel	10

Course Outcomes:

At the end of this course the students will be able to	
1	Understand random variable and probability distributions.
2	Solve problems based on probability distributions, sampling distributions and hypothesis testing
3	Use MS Excel to create tables and charts and use statistical functions of MS Excel

Bibliography:

Sr. No.	Name of Book / Authors / Publishers	Year of Publication/ Edition
1	"Statistics for Management", Levin, Rubin, Siddiqui and Rastogi, Pearson , eighth edition	2017
2	"Probability and statistics for Engineers and Scientists", Walpole, Myers, Myers and Ye, Pearson Education, 7^{th} edition.	2002
3	"Introduction to Mathematical Statistics", Hogg and Craig, Pearson Education, 5^{th} edition.	2002
4	"Miller and Freund‟s: Probability and Statistics for Engineers", Richard A. Johnson, 6^{th} edition.	2002
5	"John E. Freund‟s: Mathematical statistics with Application", Miller and Miller, Pearson Education, 7^{th} edition.	2003

Moocs Course available at:-

Essential Statistics for Data Analysis using Excel

https://www.edx.org/course/essential-statistics-data-analysis-excel

Course Name	**:**	**Numerical Methods**
Course Code	**:**	**EMM5013**
Credits	**:**	**01**
L T P	**:**	**2-0-2**
Segment	**:**	**3-4**

Total No. of Lectures– 10
Total No. of Lab hrs -10

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the basics of numerical methods.
2	To make the students able to solve problems on system of linear equations and Interpolation by numerical methods.

Course contents:

Sr. No.	Course Contents	No. of Lectures
1	**Error Analysis:** Definition and sources of errors, Propagation of errors, Floating-point arithmetic and rounding errors.	02
2	**Interpolation:** Interpolation using Finite differences, Numerical Differentiation and Numerical integration, Trapezoidal and Simpson's rules.	04
3	**Numerical Solution of Differential Equations:** Picard‟s method, Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, Predictor-Corrector method.	04

Lab Work:

Sr. No.	Lab. Contents	No. of Hours
1.	Solving Interpolation, Numerical Differentiation and Numerical integration problems using Mathematica.	04
2.	Solving Differential equations numerically using Mathematica.	06

Course Outcomes:

By the end of the course, the students will be able to :	
1.	Solve problems on Interpolation
2.	Solve problems on Differentiation, Integration
3.	Solve differential equations.

Bibliography:

Sr. No.	Name of Book / Authors / Publishers	**Year of Publication/ Edition**
1	“Introduction to Numerical Analysis”,Atkinson K. E., John Wiley.	1989
2	“Applied Numerical Analysis”, Gerald C. F. and Wheatley P. O., Pearson	2004

3	“Numerical Methods for Scientific and Engineering Computation”, Jain M. K., Iyengar S.R.K. and Jain R. K., New Age International Publisher.	2004
4	“Elements of Numerical Analysis”, Gupta R.S., Macmillan India Ltd .	2008

Course Name	**:**	**Optimization Techniques and Genetic Algorithms**
Course Code	**:**	**EMM5012**
Credits	**:**	**01**
L T P	**:**	**2-0-2**
Segment	**:**	**5-6**

Total No. of lectures: 10
Total No. of lab hours: 10

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the need of Optimization Techniques and develop the ability to form mathematical model of optimization problems.
2	To make the students able to identify and solve linear and non-linear models of optimization problems using Genetic Algorirhms.

Course Contents:

Sr. No.	Course Contents	No. of Lectures
1	Introduction to optimization problem, local and global optimum, conversion of a constrained problem to unconstrained problem.	04
2	Genetic Algorithms, Binary and Real coded Genetic Algorithms, Coding and decoding of variables, Key steps in a GA, starting population, fitness evaluation, reproduction, crossover, mutation, evaluation.	06

Lab Work:

Sr. No.	Lab. Contents	No. of Hours
1.	Using Genetic Algorithms in various optimization Problems	10

Course Outcomes:

By the end of the course, the students will be able to :	
1	The students are able to form mathematical model of optimization problems.
2	The students are able to distinguish between linear and nonlinear models.
3	The students are able to solve simple problems using Mathematica/MATLAB

Bibliography:

Sr. No.	Name of Book / Authors / Publishers	Year of Publication/ Edition
1	"Practical Genetic Algorithms", Haupt, R. L. and Haupt, S.E., John Wiley & Sons	1998
2	"Genetic Algorithm in Search, Optimization and Machine Learning" , Goldberg, D.E., Addison Wesley.	1989
3	"Engineering Optimization", Ranjan, Ganguli, University Press.	2011

SEMESTER – II

DESIGN OF EXPERIMENTS & RESEARCH METHODOLOGY

Course Name	**:**	**Design of Experiments and Research Methodology**
Course Code	**:**	**DRM5011**
Credits	**:**	**3**
L T P	**:**	**2-0-2**
Segment	**:**	**1-6**

Total No. of Lectures: 28
Total No. of Lab Hrs: 28

Course Objectives:

The main objectives of this course are:	
1.	
2.	
3.	
4.	

Course Contents:

Module I

Sr. No.	**Course contents**	**No. of lectures**
1.	**Introduction**: Types of Research and Their Purposes, Locating, Analyzing, stating and evaluating research problem, need for literature review, steps in conducting literature review, SWOT analysis, research questions and hypothesis, types of hypothesis, evaluation of hypothesis.	4
2.	**Statistical Methods of Analysis:** Descriptive statistics, Inferential statistics, Various Tests of significance based on type of input and output data, Steps involved in testing for significance, concept of p value, testing for means, Testing for variance, chi-square test- Goodness of fit, test of independence, Analysis of variance (ANOVA) - one-way, Correlation, Regression analysis	8
3.	Procedure for writing a research report and manuscript: steps of writing a report, layout of report, layout of research paper, ethical issues related to publishing, Plagiarism and Self-Plagiarism.	2
Module II (For Circuital Branch)		
5.	**Research Design and Sampling Design**: Concept of research design, features of a good research design, concept of population and sample, characteristics of sample design, types of sampling techniques	6
6.	**Methods of data collection and measurement:** Primary data and Secondary data, data collection techniques: observation, interview, questionnaires, schedules, case-study, levels of measurement, problems in measurement in research – validity, reliability.	8

Module III (For non-Circuital Branch)		
4.	Engineering Research: Planning & management of experiments; Conventional method for experiment: One factor at a time (OFAT) experiment, Concept of design of experiments: Common terms, Designed experiment, Procedure for two-way ANOVA Full factorial experiments: Orthogonality of experiments, Y = F (x) for DoE, main effect analysis, interaction analysis and results	4
5.	Fractional factorial experiments, Resolution of design, screening DoE, practicing with statistical software, Optimizing using Response Surface Methodology (RSM)	4
6.	Taguchi Methods: Difference between conventional DoE and Taguchi methods, Orthogonal arrays, Taguchi's Robust parameter design, Noise factors, S/N ratio, Selection of right orthogonal array	6

Lab work: (For non-Circuital Branch)

Sr. No.	**Lab contents**	**No. of hrs**
1.	Select a problem from your area of interest, identifying the type of research problem it is and perform the SWOT analysis of the existing literature.	4
2.	Generate research questions and hypotheses for a problem from your area of interest.	4
3.	Identify the population and sample for the study (highlighting the technique used for sample selection) for a problem from your area of interest.	4
4.	Design a questionnaire for the problem of interest.	4
5.	Utilizing software such as SPSS, Mini Tab, etc. for the statistical analysis of the results obtained for the desired questionnaire.	6
6.	Preparing a research paper for the problem of interest.	6

Lab Work: - (For non-Circuital Branch)

Performing following analysis using statistical software	
1. Hypothesis tests (Z-test, t-test, 2t test, paired t-test, Chi s square and test of equal variance etc)	5
2. Correlation analysis between independent events, Regression analysis for dependent variables (having cause & effect) and developing Y = F (x)	5
3. One-way ANOVA, Two-way ANOVA, General Linear Model	5
4. Creating and analysing 2^k Experiments (Full & Fractional Factorial) and General Full Factorial Design	5
5. Development of model using Response Surface Methodology	4
6. Creating and analysing Taguchi design	4

Course Outcomes: ((For non-Circuital Branch)

After successful completion of the course, students will be able to	
1.	Plan a research activity including sample design, scaling, data collection and analysis
2.	Perform a required statistical analysis for the a research/ experiment
3.	Understand the relationship between process variables and output as $Y = f(x) + \varepsilon$
4.	Select the appropriate orthogonal array for a Taguchi design

Bibliography

Sr. No.	**Book Detail**	**Year of Publication**
1.	Design and Analysis of Experiment, Douglas C Montgomery, John Wiley & Sons	2016
2.	Taguchi Techniques for Quality Engineering Phillip, J. Ross; The Tata McGraw-Hill	2017
3.	Research Methodology - Methods and Techniques, C. K. Kothari, New Age International, 2nd Edition	2004

PROGRAM CORE

Course Name	**:**	**Finite Element Analysis**
Course Code	**:**	**PRM5031**
Credits	**:**	**3**
L T P	**:**	**2-0-2**
Segment	**:**	**1-6**

Total No. of Lectures: 28
Total No. of Lab hrs. 28

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of designing & development of products.
2.	To understand modelling & analysis of a system using finite element analysis..

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction To FEM** The Finite Element Method, Elements and Nodes, Modeling the problem and Checking Results, Discretization and other Approximations, Responsibility of the user, Elementary Matrix Algebra.	4
2.	**Basic Concepts** Introduction, Weak formulations, Weighted residual methods, Variational formulations, weighted residual, collocation, sub domain, least square and Galerkin‟s method, direct method, potential energy method	4
3.	**One-Dimensional Analysis** Basis steps, discretization, element equations, linear and quadratic shape functions, assembly, local and global stiffness matrix and its properties, boundary conditions, applications to solid mechanics, heat and fluid mechanics problems, axisymmetric problems	4
4.	**Plane Truss** Local and global coordinate systems, stress calculations, example problems	4
5.	**Beams** Introduction, Euler-Bernoulli beam element, numerical problems	4
6.	**Scalar Field Problems In 2-D** Triangular and rectangular elements, constant strain triangle, isoparametric formulation, higher order elements, six node triangle, nine node quadrilateral, master elements, numerical integration, computer implementation, Numerical problems	4
7.	**Plane Elasticity** Review of equations of elasticity, stress-strain and strain-displacement relations, plane stress and plane strain problems	4

Lab work:

Sr. No.	Lab contents	No. of Hours
1. 2. 3. 4. 5.	To perform the structural static analysis of a corner Bracket. To perform the heat transfer analysis of a casting process. To perform magnetic Analysis of a Solenoid Actuator. To perform Interference Fit and Pin Pull-Out Contact Analysis. Probabilistic Design of a Simple Plate with a Single Force Load.	28

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to solve problems using finite element analysis.
2.	Students should be able to carry out structural and thermal analysis.
3.	Students should be able to carry out finite element analysis of consumer products.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Chandrupatla & Belegundu, „Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd., 2012	2012
2.	Huebner K.H., Dewhirst, D. L., Smith, D. E., and Byrom, T. G., "The Finite Element Method for Engineers", 4th Ed., John Wiley and Sons, 2001	2001
3.	Rao, S. S., "The Finite Element Method in Engineering", 4th Ed., Elsevier Science, 2005	2005
4.	Reddy, J.N., "An Introduction to Finite Element Methods", 3rd Ed., Tata McGraw-Hill,2005	2005
5.	Fish, J., and Belytschko, T., "A First Course in Finite Elements", 1st Ed., John Wiley and Sons, 2007	2007
6.	Chaskalovic J., "Finite Element Methods for Engineering Sciences", 1st Ed., Springer, 2008	2008

Mooc Courses are available at:

1. https://swayam.gov.in/courses/4503-basics-of-finite-element-analysis-i
2. https://www.edx.org/course/you-xian-yuan-fen-xi-yu-ying-yong-finite-tsinghuax-70120073x

Course Name	**:**	**Welding Engineering**
Course Code	**:**	**PRM5041**
Credits	**:**	**3**
L T P	**:**	**2-0-2**
Segment	**:**	**1-6**

Total No. of. Lectures: 28
Total No. of Lab hrs: 28

Course Objectives:

The main objectives of this course are:	
1.	To explain about the mechanism of metal form transfer in welding process.
2.	To understand the heat flow and temperature distribution on weld components based on weld geometry.
3.	To comprehend about the effect of welding parameters on residual stresses and distortion in weldments.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction** Classification of welding processes, physics of welding arc, arc stability, arc blow, polarity, welding symbols, safety and hazards in welding.	3
2.	**Metal Transfer** Various forces acting on a molten droplet, different modes of metal transfer & their importance in arc welding.	3
3.	**Power Sources** Types of V-I characteristics, different types of power sources, selection of the power sources.	2
4.	**Welding Consumables** Classification and selection of welding electrodes and filler rods, welding fluxes, characteristics and manufacturing of the welding fluxes, characteristics of different shielding gases.	2
5.	**Effect Of Welding Parameters On Bead Geometry** Effects of voltage current, polarity, welding speed etc. on the bead geometry and mechanical properties of the weld.	3
6.	**Welding Processes** Principle, advantages, disadvantages, application and limitations of SMAW MIG I MAG, TIG, electro-slag, electro-gas thermit welding, SAW, EBW, LBW, USW, PAW, explosive, friction and spot, seam, projection, butt, flash butt resistance welding processes, microwave welding, hybrid welding, selection of welding processes.	4
7.	**Weldability** Definition, different tests of weldability, weldabitity of steel, stainless steel, cast iron, aluminum and titanium.	2
8.	**Joining Of Ceramics And Plastics**	2

	Processes used in joining of ceramics & plastics, adhesive bonding.	
9.	**Allied Welding Processes** Brazing, soldering, metal spraying, and gas & arc cutting of steels, stainless steel and cast iron, Thermal spraying, Plasma cutting.	2
10.	**Welding Defects** Different types of welding defects, causes and remedies, testing for identifying defects.	3
11.	**Welding Distortion And Residual Stresses** Types, factors affecting the distortion and residual stresses, methods of reducing the distortion.	2

Lab Work:

Sr. No.	Lab. Contents	No. of Hours
1.	Fabricate a job after selecting the appropriate consumable and parameters. Analyse the effect of welding parameters on the heat Affected Zone by developing a mathematical model. To fabricate a job after selecting the welding parameters and analyse the effect of welding parameters on the distortion by developing a mathematical model. To inspect the fabricated job; prepare the inspection reports and suggest the remedial measures to improve the quality of the welding joints.	28

Course Outcomes:

At the end of the course, students will be able to:	
1.	Select the power source and welding consumable for a given application.
2.	Analyze the effect of welding parameters on the width of Heat Affected Zone.
3.	Suggest the remedial measure to reduce the residual stresses and distortion in weldments.
4.	Analyze the effect of various welding process parameters on the bead geometry.
5.	Recommend remedial measures to reduce welding defects.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Jean Cornu, TIG and MIG welding process, Springer, 2013	2013
2.	Jean Cornu, Advanced welding systems, IFS, 2013.	2013
3.	Parmar R.S., Welding engineering and technology, Khanna Publications, New Delhi, 1997.	1997
4.	Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2005.	2005
5.	S.V.Nadkami, Modem Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd, 2015.	2015
6.	John A. Goldak., „Computational welding Mechanics" Springer, 2005.	2005
7.	American Welding Society handbooks, Vol. 1 to 5, AWS Publications,2012.	2012

PROGRAM ELECTIVE

Course Name	**:**	**Robot Mechanics**
Course Code	**:**	**PRM5301**
Credits	**:**	**1.5**
L T P	**:**	**2-1-0**
Segment	**:**	**1-3**

Total No. of Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To introduce the students to Robot Fundamentals.
2.	To introduce the students to Robot Kinetic.
3.	To introduce the students to Robot Dynamics.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Robot Fundamentals And End Effectors** Robot components, robot classification and specification, Work envelopes, Other basic parameters of robots, Robot End-Effectors -Types, mechanical grippers, gripper force analysis, gripper selection, process tooling, compliance.	8
2.	**Robot Kinematics** Robot kinematics - spatial descriptions and transformations, inverse transformation matrices, conventions of fixing frames to links, inverse robot kinematics – solvability, algebraic vs geometric solutions, examples of inverse manipulator kinematics. Differential motion and velocities - Differential motions of a robot and its hand frame, tool configuration Jacobian, resolved motion rate control, manipulator Jacobian, static forces and moments	8
3.	**Robot Dynamics** Lagrangian mechanics, effective moments of inertia, dynamic equations for multi-degree of freedom robots.	3
4.	**Trajectory Planning** Joint space trajectories vs Cartesian space trajectories.	2

Course Outcomes:

At the end of the course, students will be able to:	
1.	Specify a robot for an industrial application.
2.	Carry out differential motion analysis for robot velocity control.
3.	Plan a robot trajectory for an industrial application.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Craig J.J., Introduction to Robotics, Pearson Education, 2005.	2005
2.	Scilling, R.J., "*Fundamentals of Robotics – Analysis & Control*", PHI.	2003

Course Name	**:**	**Ergonomics**
Course Code	**:**	**PRM5302**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**1-3**

Total No. of Lectures: 14
Total No. of Lab hrs: 14

Course Objectives:

	The main objectives of this course are:
1.	To understand the concept of designing a job for a worker considering various factors affecting a human ergonomically.
2.	To understand different methods of posture analysis.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction** Human Factors and Systems. Human Factors Research Methodologies.	5
2.	**Information Input** Information Input and Processing, Text, Graphics, Symbols and Code, Visual Display of Dynamic Information, Auditory, Tactual and Olfactory Displays, Speech Communications.	5
3.	**Human Output And Control** Physical Work and Manual Materials Handling Motor Skills, Human Control of systems, Controls and Data Entry devices, Hand tools and devices.	4

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Anthropometric investigation of student population. Posture analysis of industrial worker using RULA and REBA. Assessment of MMH task using NIOSH equation.	14

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to understand human factors & systems and human output & control.
2.	Students should be able to design a job for a worker considering various factors affecting a human ergonomically.
3.	Students should be able to design a workplace.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Mark Sanders, Ernest McCormick, Human Factors In Engineering and Design, 7th edition, McGraw-Hill International Editions, 1993.	1993
2.	Martin Helander, A Guide to human factors and ergonomics, Taylor and francis, 2005.	2005
3.	Stanton N et al, Handbook of human factors and ergonomic methods, CRC press, 2004.	2004
4.	Gallwey T J, Ergonomics Laboratory Exercises, CRC Press, 2009.	2009
5.	Bridger R.S., Introduction to ergonomics, MCGRAW HILL, 1995.	1995

Course Name	**:**	**Production Management Systems**
Course Code	**:**	**PRM5303**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**1-3**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of world class manufacturing and dynamics of material flow.
2.	To understand the concept of OPT and Lean manufacturing.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Global Competition In Manufacturing** The globalization of business, New Manufacturing- Environment, World Class Manufacturing Performance Measures, The Value Chain, Generic Competitive Advantages, Manufacturing Strategies for Global Competitiveness	6
2.	**Manufacturing Planning And Control Systems For World Class Manufacturing** Growth of Manufacturing Resource Planning, Fundamentals of Manufacturing Resource Planning, JIT Production System, Integrating MRP with JIT System	4
3.	**Dynamics Of Materials Flow** Materials flow patterns, Regulating Materials Flow, Push vs. Pull Systems, V, A, and T Plants, Effect of Process Variability on Materials Flow.	4
4.	**Optimited Production Technology And Synchronous Manufacturing** Shop scheduling and rescheduling, objectives of OPT, Maximizing Global Manufacturing Performance, Nine OPT Principles, Development of OPT Schedules, Theory of Constraints, The Drum-Buffer-Rope Strategies, Shop scheduling and rescheduling.	4
5.	**Lean And Agile Manufacturing Concepts** MIS (Management information system), ERP (Enterprise Resource Planning) / SAP (System Application & Products)	3

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to compare the existing industry with WCM companies
2.	Students should be able to apply the lean manufacturing concepts in manufacturing and service industries.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	P. Gibson, G. Greenhalgh, R. Kerr, Manufacturing Management Principles and Concepts, Chapman and Hall Publication, 2005.	2005
2.	Shgeo Shingo, Toyota Production System, Productivity Press Cambridge,2004.	2004

Course Name	**:**	**Materials Manufacturing and Design**
Course Code	**:**	**PRM5304**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**1-3**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To study various engineering materials and their selection for particular applications.
2.	To know the concept of suitable design for a given material.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Introduction** Materials Structure, nucleation & growth, phase diagrams application of phase diagram	3
2.	**Engineering Materials** Metals and their properties, ferrous and non-ferrous metals, uses, production, forming and joining of metals.	3
3.	**Ceramics And Glasses** Structures of ceramics and glasses, design properties, ceramics uses, production, forming and joining of ceramics.	4
4.	**Polymers And Composites, MMC, FRC Material Selection** Sources of information on materials properties, methods, of materials selection.	4
5.	**Design Process** Materials in design, design for brittle fracture, design for fatigue failure, design for corrosion resistance, design with plastic.	4
6.	**Case Studies In Material Selection**	3

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to understand the various properties of engineering materials.
2.	Students should be able to select engineering materials for particular application.
3.	Students should be able to design considering specific properties of a material.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Ashby M.F., Engineering Materials, Pergamon Press, 1980.	1980
2.	Dieter, GE, engineering design, A material and processing approach, MCGRAW HILL, 1983.	1983
3.	Callister, Material science and engineering, John Wiley and sons, 2018	2018

Course Name	**:**	**Industrial Robotics**
Course Code	**:**	**PRM5401**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**4-6**

Total No. Lectures: 14
Total No. of Lab Hours: 14

Course Objectives:

The main objectives of this course are:	
1.	To introduce students to the various components of an industrial robotics workcell.
2.	To introduce the students different approaches of robot programming.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Image Processing And Analysis** Image acquisition, histogram of images, thresholding, connectivity, noise reduction, edge detection, segmentation, Image analysis – object recognition, depth measurement with vision systems, stereo imaging.	5
2.	**Robot Sensors And Actuators** Robot sensors, sensor classification, micro-switches, proximitysensors, photo-electric sensors, rotary position sensors, force and torque sensors, tactile sensors, sensor usage and selection, sensors and control integration, Robotic actuating systems.	4
3.	**Robot Programming And Applications** Programming methods and languages, space position programming, motion interpolation. Robot applications – Material handling, processing, assembly, inspection applications, evaluating the potential of a robot application.	5

Lab Work:

Sr.No	Lab Contents	No. of Hours
1.	To develop a Robotic workcell using image processing	4
2.	To program a robot for pic and place application using teach pendant.	4
3.	To program a robot for a welding application	6

Course Outcomes:

At the end of the course, students will be able to:	
1.	Design a robotic workcell using image processing.
2.	Program a robot for various Industrial Applications.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Niku S.Y., Introduction to Robotics: Analysis, systems and applications, Pearson Education, 2010	2010
2.	Fu, KS.,Gongzalez RC, Lee CSG "Robotics Control, Sensing, Vision and Intelligence", *Tata McGraw-Hill*PublishingCompanyLtd.	2008

Course Name	**:**	**Applied Ergonomics**
Course Code	**:**	**PRM5402**
Credits	**:**	**1.5**
L T P	**:**	**2-0-2**
Segment	**:**	**4-6**

Total No. of Lectures: 14
Total No. of Lab hrs. 14

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of environmental conditions for a worker.
2.	To understand the concept of work-place design and human factor in organization.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Workplace Design** Applied Anthropometry, Work-space design and Seating, Arrangement of Components within a Physical Space, Interpersonal Aspects of Workplace Design	5
2.	**Environmental Conditions** Illumination, Climate, Noise, Motion	5
3.	**Human Factors Applications** Human Error, Accidents and Safety, Human Factors and the Automobile. Human Factors in Systems design	4

Lab Work:

Sr. No.	**Lab contents**	**No. of Hours**
1.	Ergonomics evaluation of office workstation. Ergonomics evaluation of a factory work cell.	14

Course Outcomes:

At the end of the course, students will be able to:	
1.	Students should be able to understand human factors & its application.
2.	Students should be able design a job for a worker with consideration of environmental conditions.
3.	Students should be able to design a workplace.

Bibliography:

Sr. No.	**Book Detail**	**Year of Publication**
1.	Mark Sanders, Ernest McCormick, Human Factors In Engineering and Design, 7th edition, McGraw-Hill International Editions, 1993.	1993
2.	Martin Helander, A Guide to human factors and ergonomics, Taylor and francis, 2005.	2005

3.	Stanton N et al, Handbook of human factors and ergonomic methods, CRC press, 2004.	2004
4.	Gallwey T J, Ergonomics Laboratory Exercises, CRC Press, 2009.	2009

Course Name	**:**	**Operations Management System**
Course Code	**:**	**PRM5403**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**4-6**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of aggregate planning and design of product, service work systems.
2.	To understand the forecasting and its importance in service and manufacturing industries.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction To Production And Operations Management** Production Systems – Nature, Importance and organizational function. Characteristics of Modern Production and Operations function. Organization of Production function. Recent Trends in Production and Operations Management. Role of Operations in Strategic Management. Production and Operations strategy – Elements and Competitive Priorities. Nature of International Operations Management	4
2.	**Forecasting, Capacity And Aggregate Planning** **Demand Forecasting –** Need, Types, course objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning – Long range, Types, Rough cut plan, Capacity Requirements Planning (CRP), Developing capacity alternatives. Aggregate Planning – Approaches, costs, relationship to Master Production schedule. Overview of MRP, MRP II and ERP	3
3.	**Design Of Product, Service And Work Systems** **Product Design –** Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Service Operations – Types, Strategies, Scheduling (Multiple resources and cyclical scheduling). Work Study – Course objectives, Procedure. Method Study and Motion Study. Work Measurement and Productivity– Measuring Productivity and Methods to improve productivity.	4
4.	**Materials Management** Materials Management – course objectives, Planning, Budgeting and Control. Overview of Materials, Management Information Systems (MMIS). Purchasing – course objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Course objectives, Costs and control techniques. Overview of JIT.	3

5.	**Project And Facility Planning** Project Management – Scheduling Techniques, PERT, CPM, Crashing CPM networks – Simple Problems. Facility Location – Theories, Steps in Selection, Location Models – Simple Problems. Facility Layout – Principles, Types, Planning tools and techniques.	4
6.	**Introduction To Production And Operations Management** Production Systems – Nature, Importance and organizational function. Characteristics of Modern Production and Operations function. Organization of Production function. Recent Trends in Production and Operations Management. Role of Operations in Strategic Management. Production and Operations strategy – Elements and Competitive Priorities. Nature of International Operations Management	3

Course Outcomes:

At the end of the course, students will be able to:	
1.	Student should be able to understand and apply principles of operations management in different areas.
2.	Student should be able to know the scope and applications of project management**.**

Bibliography:

Sr. No.	**Book Detail**	**Year of Publication**
1.	Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.	2008
2.	Pannerselvam R, Production and Operations Management, Prentice Hall India, second Edition,2008.	2008
3.	Norman gaither and Gregory frazier, operations management, south western, cengage learnings,2002.	2002
4.	Bedi Kanishka, Production and Operations Management, Oxford University Press,2004.	2004
5.	Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.	2006
6.	Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.	2008
7.	Chase Jacobs, Aquilano & Agarwal., Operations Management, Tata McGraw Hill, 2006.	2006
8.	Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007	2007

Course Name	**:**	**Plastics Processing Technology**
Course Code	**:**	**PRM5404**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**4-6**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To understand the various plastics materials, mould materials and their selection criteria & product design.
2.	To understand the various types of plastic processing techniques.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Plastics Materials** Plastics materials selection for products based on Mechanical properties and thermal behavior of plastics.	3
2.	**Mould Materials And Design** Mould materials and their selection criteria, classification of Compression Moulds, Transfer mould design, Blow mould design, Injection mould design,	4
3.	**Plastic Materials used for 3D printing** 3D printing, Fused Deposition Modelling (FDM)**,** Selective laser Sintering (SLS)	4
4.	**Plastic Processing** Blow moulding, Injection moulding, extrusion moulding, plastic forming, Roto moulding, Potting and encapsulation	5
5.	**Plastics Product Design** Design of thermoplastics and thermosetting type of polymers under static and dynamic loads, Tribological properties of polymers, abrasion and wear, design of abrasion and wear resistant products, Designing with sample composites, Product characterization, Product faults and optimum processing, Effect of processing on product performance, product characterization and service behavior.	5

Course Outcomes:

At the end of the course:	
1.	Student should be able to select different plastic materials for different applications based on their properties.
2.	Students should be able to select mould materials and to carry out mould design.
3.	Students should be able to know different plastic processing techniques.
4.	Students should be able to know about various techniques of 3D printing through plastics.
5.	Students should be able to carry out problems related to the plastics product design.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Myer Kurtz, applied plastic engineering handbook: processing and materials, Elsevier, 2011.	2011
2.	Anshuman Shrivastava, Introduction to Plastics Engineering**,** Elsevier, 2018.	2018

OPEN ELECTIVE

Course Name	**:**	**Value Engineering**
Course Code	**:**	**PRO 5001**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**1-3**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To understand the concept of value analysis and value engineering.
2.	To understand the various techniques of solving the problems pertaining to value engineering in manufacturing and service industries..

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	**Concepts And Approaches Of Value Analysis And Engineering** Concept of value, Maximum value, normal degree of value, importance of value, value oriented work, use of value resources, value work expands market and jobs, approach to prepare the mind for the value analysis techniques	4
2.	**Classification And Evaluation Of Functions** Use and aesthetic functions, Identification, clarification and naming functions, quantifying functions, unifying the function and its specifications, Analysis of Aesthetic functions, Classification of functions Evaluation of function	5
3.	**Problem Solving System** The Value Analysis Job Plan: Information step, Analysis step, Creativity step, Judgment step, Development planning step, Case study.	5
4.	**Setting And Solving Management-Decision-Type Problems** Types of Management problems, Setting the precise problem, Case Study -Should a company build manufacturing facilities for an important purchased assembly.	4
5.	**Effective Organisation For Value Work** Smallest and smaller business, One man Set Up, Two man Set Up, Three man Set Up, Four or more consultant, structuring the company, Decision Criteria-Performance and time, Decision Criteria-Performance, time, and Cost, Understanding the research and development problem.	3

Course Outcomes:

At the end of the course, students will be able to:	
1.	Student should be able to understand advanced techniques for value engineering.
2.	Student should be able to know about value engineering concepts and their applications.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Kaoufman Jerry, Value Analysis‟s Tear Down- A New Process for Product Development and innovation, Yashihiko Sato Industrial Press, 2004.	2004
2.	Bytheway Charles W, FAST Creativity and Innovation: Rapidly Improving Processes, Product Development and Solving Complex Problems, J. Ross Publishing, 2007.	2007

Course Name	**:**	**Productivity Engineering and Management**
Course Code	**:**	**PRO 5002**
Credits	**:**	**1.5**
L T P	**:**	**3-0-0**
Segment	**:**	**4-6**

Total No. Lectures: 21

Course Objectives:

The main objectives of this course are:	
1.	To introduce the basic principles of Productivity Models.
2.	To understand the various applications of Re- Engineering Concepts required in an organizations.

Course Contents:

Sr. No.	**Course contents**	**No. of Lectures**
1.	**Introduction** Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management	4
2.	**Productivity Measurement And Evaluation** Productivity measurement in International, National and Industrial level – Total Productivity Model – Productivity measurement in Manufacturing and Service sectors – Performance Objective Productivity (POP) model – Need for Productivity Evaluation	5
3.	**Productivity Planning And Implementation** Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.	5
4.	**Reengineering Process** Definition, Fundamentals of process reengineering – Principles, and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models.	4
5.	**BPR Tools And Implementation** Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.	3

Course Outcomes:

At the end of the course, students will be able to:	
1.	The Student must be able to measure and evaluate productivity
2.	Plan and implement BPR tools for improving the productivity.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Sumanth, D.J, "Productivity Engineering and Management", TMH, New Delhi, 2007.	2007
2.	Michael hammer, james champy, Reengineering the Corporation: A Manifesto for Business Revolution, 10 Oct 2006	2006