JSS MAHAVIDYAPEETHA

JSS SCIENCE & TECHNOLOGY UNIVERSITY

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

SYLLABUS VII TO VIII SEMESTER

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

(Outcome Based)

2018 Scheme

JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Scheme of Teaching and Examination for B.E (I & P Engg)

SEMESTER	CREDITS
I	19.5
II	21.5
III	26.0
IV	28.0
V	23.0
VI	25.0
VII	16.0
VIII	16.0
TOTAL	175.0

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Scheme of Teaching and Examination for B.E (I & P Engineering)

SEMESTER: III

Sl. No	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration in Hrs
				L	T	P	Total		CIE	SEE	TOTAL	
1	MA310	Engineering Mathematics -III	I & P	4	0	0	4	4	50	50	100	3 Hrs
2	IP310	Industrial Metrology	I & P	4	0	0	4	4	50	50	100	3 Hrs
3	IP310L	Industrial Metrology Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
4	IP320	Kinematics of Machines	I & P	4	0	0	4	4	50	50	100	3 Hrs
5	IP330	Fluid Mechanics	I & P	4	0	0	4	4	50	50	100	3 Hrs
6	IP340	Elements of Production Engineering	I & P	4	0	0	4	4	50	50	100	3 Hrs
7	IP340L	Production Engineering Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
8	IP350L	Computer aided Machine Drawing	I & P	0	0	3	3	6	50	50	100	3 Hrs
				Total credits			26		Total marks		700	

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Scheme of Teaching and Examination for B.E (I & P Engineering)

SEMESTER: IV

Sl. No	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration in Hrs
				L	T	P	Total		CIE	SEE	TOTAL	
1	MA410	Engineering Mathematics -IV	I & P	4	0	0	4	4	50	50	100	3 Hrs
2	IP410	Material Science & Metallurgy	I & P	4	0	0	4	4	50	50	100	3 Hrs
3	IP410L	Material Testing Lab	I & P	0	0	1	1	2	50	-	50	-
4	IP420	Dynamics of Machines	I & P	4	0	0	4	4	50	50	100	3 Hrs
5	IP430	Metal Cutting & Machine Tools	I & P	4	0	0	4	4	50	50	100	3 Hrs
6	IP430L	Metal Cutting & Machine Tools Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
7	IP440	Thermal Engineering	I & P	4	0	0	4	4	50	50	100	3 Hrs
8	IP450	Computer Aided Design	I & P	4	0	0	4	4	50	50	100	3 Hrs
9	IP450L	Computer Aided Design Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
				Total credits			28				750	

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SEMESTER: V

Sl. No	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration in Hrs
				L	T	P	Total		CIE	SEE	TOTAL	
1	IP510	Management & Entrepreneurship	I & P	4	0	0	4	4	50	50	100	3 Hrs
2	IP520	Design of Machine Elements.	I & P	4	0	0	4	4	50	50	100	3 Hrs
3	IP530	Product Design & Manufacturing	I & P	4	0	0	4	4	50	50	100	3 Hrs
4	IP540	Industrial Engineering & Ergonomics	I & P	4	0	0	4	4	50	50	100	3 Hrs
5	IP55L	Industrial Engineering & Ergonomics Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
6	IP56X	Elective I	I & P	4	0	0	4	4	50	50	100	3 Hrs
7	IP57L	Computer Aided Engineering Analysis Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
				Total credits			23		Total marks		600	

ELECTIVE I

Subject code	Engineering Stream	Subject code	Manufacturing Stream	Subject code	Management Stream	Subject code	Production Stream	Subject code	Open Stream
IP561	Maintenance Engineering & Industrial Safety	IP562	Non-Destructive Testing	IP563	Marketing Management	IP564	Theory of Metal Forming	HU560	Technical Communication and Professional Ethics

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SEMESTER: VI

Sl. No	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration in Hrs
				L	T	P	Total		CIE	SEE	TOTAL	
1	IP610	Operations Research	I & P	4	0	0	4	4	50	50	100	3 Hrs
2	IP62 L	Operation Research & Statistics Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
3	IP630	Applied Machine Design	I & P	4	0	0	4	4	50	50	100	3 Hrs
4	IP640	Quality Engineering	I & P	4	0	0	4	4	50	50	100	3 Hrs
5	IP650	Lean & Agile Manufacturing	I & P	4	0	0	4	4	50	50	100	3 Hrs
6	IP66X	Elective II	I & P	4	0	0	4	4	50	50	100	3 Hrs
7	IP67L	Computer Aided Manufacturing Lab	I & P	0	0	1.5	1.5	3	50	-	50	-
8	HU610G	Foreign Language (German)	Humanities	2	0	0	2	2	50	50	100	2 Hrs
				Total credits			25		Total marks		700	

ELECTIVE II									
Subject code	Engineering Stream	Subject code	Manufacturing Stream	Subject code	Management Stream	Subject code	Open Stream	Subject code	Production Stream
IP661	Mechatronics & Robotics Systems	IP662	Composite Materials	IP663	Energy Engineering & Management	IP664	Automatic Control Engineering	IP665	Non Traditional Machining.

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SEMESTER: VII

Sl. No	Subject code	Course title	Teaching department	Credits				Contact hours	Marks			Exam duration in hrs
				L	T	P	Total					
1	IP710	Hydraulics & Pneumatics	I & P	3	0	0	3	3	50	50	100	3 Hrs
2	IP720	Plant Layout and Design	I & P	3	0	0	3	3	50	50	100	3 Hrs
3	IP730	Operations Management	I & P	3	0	0	3	3	50	50	100	3 Hrs
4	IP74X	Elective III	I & P	3	0	0	3	3	50	50	100	3 Hrs
5	IP75X	Elective IV	I & P	3	0	0	3	3	50	50	100	3 Hrs
6	IP76S	Seminar	I & P	1	0	0	1	1	50	-	50	
			Total credits				16	Total marks			550	

ELECTIVE III

Subject code	Industrial Engineering Stream	Subject code	Manufacturing Stream	Subject code	Management Stream	Subject code	Design Stream
IP741	Industry 4.0	IP742	World Class Manufacturing Practices	IP743	Human Resource Management	IP744	Mechanical Vibrations

ELECTIVE IV

Subject code	Industrial Engineering Stream	Subject code	Manufacturing Stream	Subject code	Management Stream	Subject code	Design Stream
IP751	Engineering Economics	IP752	Technology Management	IP753	Organizational Behavior	IP754	Tool Engineering Design and Fixtures

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Scheme of Teaching and Examination for B.E (I & P Engineering)

SEMESTER: VIII

Sl. No	Subject code	Course title	Teaching department	Credits				Contact hours	Marks			Exam duration in hrs
				L	T	P	Total					
1	IP810	Computer Integrated Manufacturing	I & P	3	0	0	3	3	50	50	100	3 Hrs
2	IP82X	Elective V	I & P	3	0	0	3	3	50	50	100	3 Hrs
4	IP83P	Project Work	I & P	0	0	10	10	20	70	30	100	3 Hrs
				Total credits			16		Total marks		300	

OPEN ELECTIVE V							
Subject code	Industrial Engineering Stream	Subject code	Manufacturing Stream	Subject code	Management Stream	Subject code	Engineering Stream
IP821	Just in Time Manufacturing	IP822	Additive Manufacturing.	IP823	Supply Chain Management.	IP824	Industrial Robotics

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Program Outcome for Under Graduate Programme

PO 1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

PO 5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

PO 7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainabledevelopment.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities andnorms of the engineeringpractice.

PO 9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clearinstructions.

PO 11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinaryenvironments.

PO 12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Programme Educational Objectives for Under Graduate Programme:

PEO1: Graduates get employed in professions related to Industrial and Production Engineering adopting and adapting to advances intechnology and management.
PEO2: Graduates pursue advanced studies at Institutions of higher learning to engage in research and learning stimulations facilitatingthem to attain technical competence with an aptitude for life-long learning.
PEO3: Graduates become successful professionals in a challenging environment leveraging learnings for the growth of the organization bybecoming successful intrapreneurs keeping in mind the ethical responsibilities and volatile emerging societal needs.

Program Specific Outcomes (PSOs):

- Tocreatequalifiedbudding,versatileandmultifacetedEngineerstosolverealworldproblems arising in the areas of Industrial production andManagement.
- To imbibe confidence in students to start entrepreneurship on a small scale and become Successful entrepreneurs in thefuture
- To produce Engineers witha blend of both theory and practical knowledge in the field of manufacturing, management anddesign &to develop students with excellent presentation skills to take up innovative projects in industries

NOTE: Students must refer to NPTEL, SWAYAM portal, Scopus Indexed and Web of Science Indexed journals for all the courses.

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Subject Name & Code	**INDUSTRIAL METROLOGY IP 310**
No. of Teaching Hours – 52	**Credits:4:0:0 L-T-P**

On successful completion of the course, the students will be able to:

Course Outcome:

1. Understand the concept of standards of measurements and apply the concepts in learning the working of transducers and to apply transducer concept of measurements in the determination of force andtorque
2. Apply the concepts of transducers in the measurement of pressure and apply mathematical inputs in arriving at limits, fits,tolerance.
3. Understand the basic concepts of gauges and comparator application through experimentallearnings
4. Understand the basic concepts of screw threads and Gear measurements with the mathematical approaches.
5. Understand the concepts of temperature and strain measurements with the industrial applications.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Standards of measurement:** Definition, Significance of measurement, generalized measurement system, definition and concept of accuracy, precision, errors in measurement, classification of errors. Line & End Standards Transducers - Primary and secondary transducers, Mechanical, Electrical, Electronic transducer, advantages of each type transducers.	05 Hrs.
02	**Measurement of Force and Torque:** Principle, analytical balance, platform balance, proving ring, Torque measurement: Prony brake, hydraulic dynamometer and other applications	05 Hrs
	UNIT II	
03	**Pressure Measurements:** Principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani Gauge and other important gauges for pressure measurements and other applications	05 Hrs
04	**System of Limits, Fits, Tolerances and gauging :** Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly , limits of size, concept of limits of size and tolerances, Definition of fits, types of fits and their designation, Geometrical tolerance, positional tolerances, Hole basis and shaft basis of system. Problems	07 Hrs

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	UNIT III	
05	**Classification of gauges**: Brief concept of design of gauges (Taylor's Principles), Wear allowance on gauges, Types of gauges - plain plug gauge, ring gauge, snap gauge, limit gauge, gauge materials. Problems	06 Hrs
06	**Introduction to Comparator**: Characteristics, classification of comparators – Mechanical comparators - Johnson Mikrokator, Sigma Comparators, dial indicator, Optical Comparators - Principles, Zeiss ultra optimeter, Linear Variable Differential Transformer (LVDT)., Pneumatic Comparators , Back pressure gauges, Solex Comparators	06 Hrs
	UNIT IV	
07	**Screw thread and Gear measurement :** Terminology of screw threads, Measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire methods, best size wire, Gear terminology, use of gear tooth, Vernier caliper and gear tooth micrometer.Instrumentsusedforgearmeasurementandothersurface measurements applications.	08 Hrs
	UNIT V	
08	**Temperature Measurement:** Devices used for Temperature measurements, thermocouples, pyrometers, and other applications of temperature measurements.	05 Hrs
09	**Strain Measurement:** Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement and other applications of strain gauges	05 Hrs

TEXT BOOKS:

1. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Engineering Metrology, R.K. Jain, Khanna Publishers,1994.

REFERENCE BOOKS:

1. Engineering Metrology & Measurements: Dr. N.V.Raghavendra& Dr.L.Krishnamurthy
2. Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications,Delhi.
3. Mechanical Measurements, R.K. Jain Khanna Publishers,1994
4. Industrial Instrumentation, Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd.2002.
5. Measurement Systems Applications and Design, Ernest O.Doebelin, 5th Ed.,McGraw Hill BookCo.
6. Metrology & Measurement, Anand K. Bewoor& Vinay A. Kulkarni, Tata McGrawHill Pvt. Ltd.,New-Delhi

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Subject Name & Code	**METROLOGY LAB , IP 310L**
No. of Teaching Hours – 39	**Credits :0:0:1.5**

Course Outcome:

On successful completion of the course, the students will be able to:

1. Demonstrate the calibration of different metrologicalinstruments.
2. Identify the parameters of measuring equipments used ininspection

Sl. No	**Topics**	**Hrs**
1	Usage of Micrometer, Vernier calipers & depth gauge for measurement of basic components. Telescopic gauge, internal micrometer, use of height gauge, height master and other gauges.	**6 Hrs**
2	Measurements of thread parameters and measurement of flat surfaces and radius of curvature using Optical Projector / Toolmaker Microscope	**6 Hrs**
3	Setting of angles using Sine Center / Sine bar / bevel protractor, slip gauges and Measurement of taper angles using bevel protractor, sine centre and standards	**3Hrs**
4	Measurements of alignment using Autocollimator – straightness, flatness.	**3 Hrs**
5	Measurements of Screw thread Parameters using floating carriage micrometer (using two wire method)	**3 Hrs**
6	Measurements of Surface roughness using perthometer and other related surface measurement devices.	**3 Hrs**
7	Comparators- mechanical & Electronic comparators and its applications	**3 Hrs**
8	Measurements of gear tooth profile using gear tooth vernier /gear tooth micrometer.	**6 Hrs**
9	Calibration of micrometer using slip gauges, Dial gauge	**3 Hrs**
10	Acceptance & Alignment tests of Lathe and Milling Machines	**3 Hrs**

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Subject Name & Code	**KINEMATICS OF MACHINESIP320**
No. of Teaching Hours – 52	**Credits : 4-0-0 L-T-P**

Course Outcome: On successful completion of the course the student will be able to apply mathematics, science and engineering knowledge to

CO1: Define, identify and explain different types of mechanisms, classification of gears, gear tooth nomenclature, interference in gears, nomenclature of cams and followers.

CO2: Apply the knowledge to determine the degrees of freedom using Grubler's criterion, contact ratio and minimum number of teeth to avoid interference in gears etc.

CO3: Analyze velocity and acceleration analysis in mechanisms, epicyclic gear trains etc.

CO4: Synthesize mechanisms like slider crank mechanism, quick return mechanism; construct cam profiles for different types of followers with different types of follower's motions.

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	**Introduction:** Definitions: kinematic link, kinematic pairs, kinematic chain, machine, Mechanism, inversion, degrees of freedom, Grashof's criterion of movability Grubler's criterion. Inversions of four bar chain- single slider crank chain, double slider crank chain.	07 Hrs.
02	**Mechanisms with lower pairs**- straight line motion mechanisms pantograph, Toggle mechanism, Ackerman steering gear mechanism, intermittent motion mechanisms- Geneva mechanisms , Ratchet and pawl mechanism	07 Hrs
	UNIT II	
03	**Velocity analysis of mechanisms**- introduction, absolute and relative motion of a link, four link mechanism, angular velocity of links, slider crank mechanism, crank and slotted lever mechanism, toggle mechanism.	06 Hrs.
04	**Acceleration analysis of mechanisms**-four link mechanism, slider crank mechanism, acceleration of intermediate and offset points, slider crank mechanism, Coriolis component of acceleration, crank and slotted lever mechanism, Analysis of Single slider crank mechanism using Kleins Constructions	07 Hrs
	UNIT III	
05	**Synthesis of mechanisms:** introduction, type synthesis, dimensional synthesis, number synthesis-associated link concept, tasks of kinematic synthesis, limit positions, dead centre, transmission angles, synthesis of four bar mechanisms-two position and three position, synthesis of slider crank mechanism,synthesisofquickreturnmechanism,freudensteinsmethod, Bloch's synthesis.	06 Hrs

	UNIT IV	
06	**Gears**: Gear terminology, laws of gearing, characteristics of involute action, path of contact, Arc of contact, contact ratio, interference in involute gears, methods to avoid interference, back lash, comparison of involute and cycloidal tooth profile.	06 Hrs
07	**Gear trains**: Simple gear trains. Compound gear trains, reverted gear trains, Epicyclic gear trains. Tubular method of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.	06 Hrs
	UNIT V	
08	**Cams**: Definition, types of followers, types of Cams, terminology, displacement, velocity, acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife edge roller, and flat faced follower. Disc cam with oscillating roller follower, follower motions including SHM, Uniform velocity, uniform acceleration & retardation and cycloidal motion.	07 Hrs.

TEXT BOOKS :

1. **Theory of Machines –** Ghosh &Mallik
2. **Theory of machines** - Ratan S.S Tata Mcgrew Hill Publishing companyLtd New delhi 2nd edition 2005.
3. **Theory of machines and mechanism**- Prof. P.L.Ballaney -Khanna Publications2003.

REFERENCE BOOKS:

1. Theory of machines - Thomos Bevan , CBSPublications
2. Theory of machines - Shiegly Joseph Ediminster TMHPublication
3. Theory of machines - A sadhu Singh. -Pearson Edn2002
4. Theory of machines - Jagadishlal- Jainbrothers
5. Theory of machines and mechanisms - Shiegal J.V and Vickers JJ- oxford university press –2004.
6. Mechanics of Machines – Ramamurthy, IIT Chennai- Narosa Publications]
7. Theory of Machines – J.S.Rao and Dukkipatti – WorkedExamples
8. Theory of Machines – Mabie&Ockvirck
9. Theory of mechanisms and machines by C S Sharma, KamaleshPurohit- PHI privateltd. New Delhi-2006edition.

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Subject Name & Code	FLUID MECHANICS IP330
No. of Teaching Hours – 52	Credits : 4:0:0

Course Outcome:

On successful completion of the course, the students will be able to:

1. Understand the concept &properties of fluid and learn concept of fluid statics and estimate the variations of pressure in a static mass offluid.
2. Understand and analyze the concepts of fluid kinematics with emphasis on continuity and other equations with numerical problems. Arrive at dimensional numbers using the concepts of dimensional analysis and to derive thetheorems.
3. Understand the concepts of fluid dynamics and fluid flow measurements and analyze the various cases with the help of numerical problems.
4. Understand the concepts of Laminar &Viscous flow and analyze with the help of numericalproblems.
5. Explain the flow past immersed bodies and analyze with the help of numerical problems andtheorems.

Chap No.	Topics	Hrs
	UNIT I	
01	**Properties of Fluids:** Introduction, of Fluids, Viscosity, Thermo dynamic properties, Surface tension and Capillarity, Vapour pressure &Cavitations	06 Hrs
02	**Fluid Statics:** Fluid pressure at a point, Pascal's Law, Pressure variation in a static fluid, Absolute , Gauge, Atmospheric and Vacuum Pressures, Simple manometers, Differential Manometers, Total pressure and Center of Pressure, Vertical Plane, Horizontal plane, Inclined, Curved Surface submerged in liquid, Buoyancy, Centre of buoyancy, metacenter and metacentric height, Conditions of equilibrium of floating and submerged bodies	07 Hrs
	UNIT II	
03	**Fluid Kinematics:** Types of Fluid flow, Introduction, Continuity equation, continuity equation in three dimensions(Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function	07 Hrs

04	**Dimensional Analysis:** Introduction, Derived quantities, dimensions of physical quantities, dimensional homogeneity (No Derivation)	**04 Hrs**
	UNIT III	
05	**Fluid Dynamics:** Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation, Euler's equation, Bernoulli's equation for real fluids.	0**6 Hrs**
06	**Fluid Flow measurements:** Introduction, Venturimeter, orifice meter, pitot tube. Flow through pipes - Frictional loss in pipe flow, Darcy- Equation for loss ofheadduetofrictioninpipes,Chezy'sequationforlossofheadduetofriction in pipes, hydraulic gradient and total energy line.	**06 Hrs**
	UNIT IV	
07	**Laminar and Viscous Flow effects:** Reynolds's number, critical Reynolds's number, Laminar flow through circular pipe-Laminar Flow between parallel and stationery plates.	**08 Hrs**
	UNIT V	
08	**Flow past immersed bodies:** Drag Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, displacement thickness, momentum thickness and energy thickness. Introduction to Compressible flow: Velocity of sound in a fluid, Mach number	**08 Hrs**

TEXTBOOKS:

1. **Fluid Mechanics -** Dr.BanssalR.K , Lakshmi Publications,2004.
2. **Fluid Mechanics and Hydraulics** - Dr.Jagadishlal , Metropolitan Book Co. Ltd.,1997.

REFERENCEBOOKS:

1. **Fluid Mechanics**-Yunus A .Cingel john M.Oimbala, TATA McGraw hill Publications 2006
2. **Fluid Mechanics -** Oijshush K. Kundu, Iram Cochin, El Sevier 3rd Edition2005.
3. **Fluid Mechanics –**Govind Rao , IISC,Bangalore

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Subject Name & Code	ELEMENTS OFPRODUCTIONENGINEERING IP340
No. of Teaching Hours – 52	Credits : 4:0:0 L-T-P

Course Outcome:

On successful completion of the course, the students will be able to:

1. Understand the concept of manufacturing Process and its importance and methods of manufacturing process like casting, pattern andcores.
2. Understand the sand mouldings, metal mouldings and special mouldings and its different methods and constructional features of different types of meltingfurnaces
3. Understand the concept of welding process and special types of weldingprocess
4. Know the metallurgical concept of welding and their properties and defects ofwelding
5. Apply the concepts of brazing and soldering for differentapplications.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Casting Process:** Introduction: Concept of Manufacturing process. Importance, Classifications of manufacturing process, Introduction to casting process, steps involving casting process, varieties of product producing casting process, merits and demerits of casting process, use of casting as primary operation.	04 Hrs.
02	**Definition of pattern:** Functions- material used for pattern allowances & their importance, classifications & patterns binders & additives: Types of binders – used in moulding shop, definition of binders and additives types additives used in moulding. . **Cores:** Definition need of cores & types in cores, Method of making cores binders used in cores concept of gating &risering principles. Fettling & Cleaning of castings, casting defects- Causes features & remedies. Moulding Machines: Jolt type, Squeeze type sand slinger	05 Hrs
	UNIT II	
03	**Sand Moulding**: Types base sand requirement of base sand, types of sand mould. Sand moulds: Moulding sand (base sand) binder & additives, Methods used for sand moulding. **Special Moulding process**: Green sand moulding, core sand, moulding dry sand. Sweep moulding CO_2Mould, Shell Mould, investment mould	06 Hrs
	Metal Moulds: Gravity die casting pressure die casting, centrifugal casting, slush casting continues casting process	
04	**Melting Furnaces**: Classification of furnaces, Constructional features, working principle of following: Gas fired furnace. Resistance furnace, Electrical furnace Cupola furnace .	06 Hrs

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	UNIT III	
05	**Welding process**: Definition principles of welding, classification of welding applications of merits and demerits of welding. Filler rods fluxes: Defection causes and remedies of well defects Arc Welding- Principle of Arc welding, Metal arc welding (MAW) FSMAW, Inert gas welding (GMAW). Gas welding- Principle of gas welding, or Oxy - Acetylene welding, chemical reaction of gas welding, gas cutting & types of gas cutting machines.	06 Hrs
06	**Special Types of welding-** Resistance welding, Principle of resistance welding, types of resistance welding- seam welding & pot welding butt welding projectionwelding.FrictionWelding-Explosionwelding,ThermalWelding Laser welding, Electron Welding, Applications Merits and demerits.	05 Hrs
	UNIT IV	
07	**Metallurgical concepts in welding**: Definition, concept of different zones formed during welding heat affected zones(HAZ) Factors affecting zone, affect of carbon content on structures & properties of steel, Shrinkage in welds , Residual stresses involved.	10 Hrs
	UNIT V	
08	**Principles of soldering brazing and adhesive bonding:** Different types of soldering brazing adhesive bonding methods Inspections of Testing of welding and casting process	05 Hrs
09	**Destructive & Non Destructive Methods:** Introduction,types of destructive testing, different types of non destructive testing: visual magnetic particle testing Ultrasonic Radiography	05 Hrs

TEXT BOOKS:

1. **Manufacturing Technology** - Foundry forming welding by P.N.Rao Secondedition.
2. **Manufacturing Process**-I - A.C.Niranjan – Poojapublications.
3. **Manufacturing Process-I** - Dr. K.Radhakrisha. FifthEditions
4. **Manufacturing Process** - H.D.Ramachandra

REFERENCE BOOKS:

1. **"Process and Materials of Manufacturing**", Roy A Lindberg, 4th Ed.PearsonEdu. 2012
2. **"Manufacturing Technology**", SeropeKalpakjian, Steuen. R. Sechmid,Pearson Education Asia, 5th Ed.2012.

JSS MAHAVIDYAPEETHA

JSS SCIENCE & TECHNOLOGY UNIVERSITY

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**PRODUCTION ENGINEERING LAB IP340L**
No. of Teaching Hours – 39	**Credits :0:0:1.5**

Course Outcome:

On successful completion of the course the student will able

1. To prepare different moulds forcasting.
2. To analyze the different properties of mouldingsands
3. To learn the sheet metal development andassembly

Sl. No	**Topics**	**Hrs**
01	**Foundry Laboratory:** a. Permeability & Compression Tests on Foundry Sand & plot the characteristicGraphs. b. Practice classes on the preparation of moulds, mould cavity usingmanual type &patterns. **Note: 4 models have to be prepared.**	**6Hrs Theory 12 Hrs Lab**
02	**Sheet Metal Work:**Theory and Fabrications a. Development of frustum of cones, prisms, pyramids ,Transition pieces – Theory to be taught b. Development of Funnel & Simple Tray. c. Cutting, Fabricating using various operations of Sheet metalwork. d. Study on clearances and its effects e. Types of sheet metals and its characteristic properties f. Soldering of the foldedjoints. **Note: 4 Models have to be prepared.**	**9 Hrs Theory 12 Hrs Lab**

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**COMPUTER AIDED MACHINE DRAWING IP350L**
No. of Teaching Hours – 72	**Credits : 0:0:3 Exam : 3 Hrs Marks 100**

Course Outcome:

On successful completion of the course the student will able to

1. Visualize the isometric view of an object and project its front view , top view and profile view with all the relevantdimensions.
2. Place the section line on the solids and draw the true shape of the sectionedobject.
3. Apply techniques necessary to complete engineering drawings of standard fasteners (nuts, bolts,screws)
4. Draw the various keys and riveted joints for various industrialapplications
5. Design the coupling required for different shafts using 3D model of all the parts of the assembly individually and finally assemble the parts using solidedge

Chap. No.	Topics	Hrs
01	**Orthographic Views:** Conversion of pictorial views into orthographic projections. of simple machine parts with or without section – 4 Examples	06 Hrs.
02	**Thread forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread	06 Hrs.
03	**Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut, Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw	06 Hrs
04	**Keys & Joints:** Parallel key, Taper key, Feather key, Gib head key and Woodruff key. **Riveted Joints:** Single and double riveted lap joints, butt jointswithsingle/doublecoverstraps(ChainandZigzag,usingsnaphead rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.	06 Hrs

07	**Couplings:** Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)	**06 Hrs**
08	**Assembly Drawings (Part drawings should be given)** 1. Plummer block (PedestalBearing) 2. Screw jack (Bottletype) 3. Tailstock oflathe 4. Machinevice 5. Tool Head of ashaper	**42 Hrs**

TEXT BOOKS :

1. 'Machine Drawing' , K.R. Gopala Krishna, Subhash Publication
2. 'Machine Drawing', N.D.Bhat&V.M.Panchal
3. 'A Primer on Computer Aided Machine Drawing', Published by VTU,Belgaum.

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JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**MATERIAL SCIENCE & METALLURGYIP410**
No. of Teaching Hours – 52	**Credits : 4:0:0**

Course Outcome:

On successful completion of the course, the students will be able to:

1. Understand the structure and diffusion concepts and to correlate with the material properties
2. Familiarize various material testing procedures and able to identify the behavior of different materials under variousconditions
3. Understand and analyse the concept of solidification and to apply it in arriving at various phase diagrams and mechanisms behind the formation of alloys, solid solutions, mechanical mixtures,etc
4. Specifically study the need, structure and application of Fe-C equilibrium diagram & TTTdiagram
5. To apply the knowledge of metallurgical concepts in understanding various heat treatment processes and application of the same under various scenarios and also familiarize with various engineering materials, alloys, theirclassifications.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Structure of solids:** classification, Bravais space lattice, Miller indices. X-ray diffraction, Bragg's law, problems related to density calculation. Crystal Imperfections.	**05 Hrs.**
02	**Diffusion:** Mechanism, Fick's 1st and 2nd Laws of diffusion, types of diffusion Factors affecting diffusion, Application.	**05 Hrs**
	UNIT II	
03	**Mechanical Behaviour of Materials**: Mechanism of elastic action, Relationship between stress and strain. Linear and nonlinear elastic properties, inelastic properties, conventional stress, and true stress, conventional strain andtruestrainplasticdeformationbyslipandtwinningstrainhardening,re-crystallization and grain growth	**06 Hrs**

04	**Fracture, Fatigue and Creep:** Introduction to Griffith Theory, Fracture toughness, Fatigue Fracture. Creep- Definition, stages of creep, creep properties. Fatigue – Definition, S-N Diagram, Fatigue properties, factor affecting fatigue strength.	**04 Hrs**
	UNIT III	
04	**Solidification of metal alloys:** Definition, nucleation and its types, crystal growth, cast metal structures.	**04 Hrs**
05	**Phase Diagrams:** Solid solutions, Hume – Rothery principles, Gibb's phase rule, types of phase diagrams and their constructions, problems on equilibrium diagrams – All Cases	**06 Hrs**
	UNIT IV	
06	**Iron carbon systems:** Solidification of pure iron, construction of Fe-C equilibrium diagram, types of phases, invariant reactions, TTT diagram and Continuous cooling curves. Study on Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM) and its characteristics (Case Examples)	**10 Hrs**
	UNIT V	
07	**Heat treatment of Steels:** Need, purpose, process- annealing, normalizing, hardening, tempering , mar-tempering, aus-tempering, hardenability, surface heat treatments- carburizing, nitriding and cyaniding.	**06 Hrs**
08	**Ferrous and nonferrous materials:** Properties composition and applications of steel C.I, copper alloys, aluminum alloys. Advanced Materials - Composites, its classification, brief knowledge about metal matrix and polymer matrix composites, ceramics and their types, memory alloys.	**06 Hrs**

TEXT BOOKS :

1. **Material Science and processes** :Hazra S.K. &Choudhary, Media promoters and Publishers Pvt.Ltd.
2. **Physical Metallurgy**- Y. Lakhitin ,MirPub.

REFERENCE BOOKS:

1. **Material Science and processes**: Dr. M.K. Muralidhara, Dhanpath Raipublication Company, NewDelhi.
2. **Elements of Material Science and Engineering**: Van Vlack H & Lawrence, Addison WesleyPublication.
3. **Material Science and Engineering** : William D. Callister Jr, John Wiley & sonsInc.
4. **Materials Science** –V.Richards
5. **Material Science and Engineering** : V. Raghavan Prentice Hall of India, NewDelhi

JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**MATERIAL TESTING LABORATORY, IP410L**
No. of Teaching Hours – 30	**Credits :0:0:1**

Course Outcome:

On successful completion of the course, the students will be able to:

1. Demonstrate and determine hardness test of metallic and non metallicmaterials.
2. Demonstrate and determine impact test of metallic and non metallicmaterials.
3. Demonstrate and determine tension test of metallic and non metallicmaterials.
4. Demonstrate and determine compression test of metallic and non metallicmaterials.
5. Demonstrate and determine bending and double shear test of metallic and non metallic materials.

Sl. No	Topics	Hrs
1	**Hardness Test:** Estimating the Hardness of different Engineering materials usingBrinell's& Rockwell Hardness Testers.	06 Hrs
2	**Impact Test:** Determining the impact strength for a given material using Charpy& IZOD tests.	06 Hrs
3	**Tension Tests using Universal Testing Machine :** Tension test on the given specimens (atleast 2 materials for comparison) and to plot the stress strain graphs	06 Hrs
4	**Compression Tests using Universal Testing Machine :** Compression test on the given specimens (atleast 2 materials for comparison) and to plot the stress strain graphs	06 Hrs
5	**Bending and Double Shear Tests using Universal Testing Machine:** Bending test, Double Shear test on the given specimens (atleast 2 materials for comparison) and to plot the stress strain graphs.	06 Hrs

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**DYNAMICS OF MACHINES IP 420**
No. of Teaching Hours – 52	**Credits : 4:0:0**

Course Outcome: On successful completion of the course the student will able to Apply Mathematics, Science and Engineering knowledge to

CO1: Define and explain static force analysis of four bar mechanism, engine mechanism, and friction in pivot and collar bearings, turning moment diagrams for single cylinder and multi cylinder engines, flywheel, balancing of rotating and reciprocating masses, flat belt and V belt drives, and types of vibrations.

CO2: Apply the knowledge to determine the constrained forces and input torque in four bar mechanisms, size of fly wheel, unbalance forces and couples in machines, power transmitted by the belt drives, cross section of the belt etc.

CO3: Analyze static forces in four bar mechanism, engine mechanism; analyze flat belt drive, V-belt drive and rope drive.Analyze the motion of followers (roller and flat faced) for cams with specified contour.

CO3: Investigate the reliability and safety of machinesand hencereduce imbalance and shaking forces of rotating and reciprocating parts

CO4: design fly wheels for engines, punching press, shearing and riveting machines.Perform vibration analysis of real word systems and hence design machines which are eco friendly in a sustainable environment.

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	**Static Force Analysis**: Introduction, Reaction between members, transmissionofforces,analysisofenginemechanism,engineforceanalysis-kinetically equivalent system or dynamically equivalent system.	**07 Hrs**
02	**Friction:** Friction, types of friction laws of solid friction, co-efficient of friction, friction between sliding pair, friction between turning pairs, friction in collar & pivot (Thrust bearing). Flat pivot bearing, conical pivot bearings flat collar bearing..	**05 Hrs**
	UNIT II	
03	**Turning moment diagrams and flywheel :** Introduction , turning moment diagram (TMD) for single cylinder double acting steam engine, TMD for 4 Stroke or IC engine , TMD for multi cylinder engine, types of flywheel, important definitions , relation between E, e_{max} and K_s or Relationship between e_{max} and K_s& I. Prove that $K_e / K_s = 2$, C= 0.02qE, Flywheel in punching press.	**10 Hrs**
	UNIT III	
04	**Balancing of Machinery**: Static and Dynamic balancing, balancing of single rotating masses in same plane and in different planes, balancing of several rotating masses in same and different planes. Balancing of reciprocating masses. Partial primary balancing of single cylinder engine, balancing in multi cylinder- inline engine (primary and Secondary Forces) V- Type, radial engine –direct and reverse crank method.	**10 Hrs**

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	UNIT IV	
05	**Flexible connectors:** Flat belt drives, velocity ratio, initial tension, length of open belt and cross belt drives, angle of wrap, ratio of belt tensions, effect of centrifugal tension, transmission of power, maximum power condition, V- belt and rope drives, ratio of belt tensions for V-belt or rope drives, advantages of V-belt over flat belt drives.	**08 Hrs**
	UNIT V	
06	**Vibrations in machines** - Definitions, types of vibrations, longitudinal vibrations, free vibrations, damped vibrations, logarithmic decrement, forced – damped vibrations, magnification factor, vibration isolation and transmissibility.Freetorsionalvibration-singlerotor,multirotorsystems. Simple problems	**06 Hrs.**
07	**Cam Dynamics:** cam with specified contours, tangent cam with roller follower, circular arc size with flat faced follower , cam size determination. (analytical methods)	**06 Hrs.**

TEXT BOOKS :

1. Theory of Machines and Mechanism s by Shigley J.V. Vickers J.J oxford university press 2004

REFERENCE BOOKS:

1. Theory of Machines by Thomos Bevan, CBSpub
2. Theory of Machines by A. Sadhu singh, pearson education2002.
3. Theory of Machines by Jagadishlal, jainbrothers.
4. Theory of Machines by S.S. Rattan, TMHpub
5. Dynamics of Machinery by J.B.K Das and P.L. Srinivasa Murthy(2005)
6. Worked examples in Theory of Machines –J.S.Rao
7. Dynamics of Machinery –Holovenko
8. Kinematics & Dynamics of Machinery – GreamyHirschoron

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**METAL CUTTING & MACHINE TOOLS IP 430**
No. of Teaching Hours – 52	**Credits : 4:0:0**

Course Outcome:

On successful completion of the course, the students will be able to:

1. Recognize various metal cuttingoperations.
2. Understand the properties and concepts of different types of cutting tool materials & cuttingfluids
3. Understand the working concepts of turning machine and drilling machine and its operations.
4. Understand the working concepts of shaping machine and milling machine and its operations.
5. Understand the working concepts of grinding machine and its operations.

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	**Theory of Metal Cutting:** Single point cutting tool nomenclature, geometry, Study of different types of tool inserts and tool holders Characteristics graphs on the effects of cutting conditions on Metal Removal Rate (MRR), concept of Machinability.orthogonalandobliquecutting,Mechanismofchipformation, types of chips, Merchant circle diagram, shear angle relationship, Problems	**07 Hrs.**
02	**Cutting tool materials:** Desired properties, types of cutting tool materials – HSS, carbides, coated carbides, nitrides, ceramics, Aluminium oxide- (grinding tool materials), and cubic boron nitride, diamond and Case studies on recent cutting tool materials and their applications,	**05 Hrs**
	UNIT II	
03	**Tool Life & Tool wear:** Types & Forms of Tool Wear and tool failure & effects of cutting parameters, Tool life criteria, Taylor's tool life equation, and problemsontoollife,Heatgenerationinmetalcutting,factorsaffectingheat generation, measurement of tool tip temperature	**05 Hrs**
04	**Cutting Fluids:** Types & properties of cutting fluids and selection. Effects of cutting fluids on Machinability, characteristic graphs of the effects of cutting fluids on Metal Removal Rate (MRR).	**05 Hrs**

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

	UNIT III	
05	**Turning Machines:** Introduction, types of lathes –Capstan & Turret Lathes, comparison of lathes, constructional features, operations, different methods of taper turning, apron mechanisms, gear combination calculations for thread cutting, work holding & tool holding devices	**05 Hrs**
06	**Drilling Machines:** Classification, constructional features, Radial and Pillar drilling machines, operations of drilling machines with counter sinking and counter boring operations, nomenclature of a twist drill bit and reamer, applications.	**05 Hrs**
	UNIT IV	
07	**Shaping and Gear Shaping Machines:** Construction features, and operations of Shaping and Gear Shaping Machines, horizontal broaching machines for cutting gear teeth	**05 Hrs**
08	**Milling Machines:** Classification, constructional features, milling cutters nomenclatures, Milling operations, up milling and down milling concepts and its applications	**05 Hrs**
	UNIT V	
09	**Grinding Machines:** Classification, constructional features, Specification of Grinding wheel, Selection of Grinding wheels, Balancing of Grinding wheel andMountingofGrindingwheels,TypesofAbrasives,bondingprocess, Centerless Grinding Machines & its applications	**05 Hrs**
10	**Super finishing process:** Honing, lapping and super finishing operations, tools, working principles, applications with case examples	**05 Hrs**

TEXT BOOKS:

1. **Production Technology**: HMT – Tata McGraw Hill
2. **Production Technology**: R.K.Jain, KhannaPublications
3. **Manufacturing Process and materials of manufacture**: Roy A. Lindberg Prentice Hall of India,
4. **Fundamentals of metal machining and machine tools:** G. Boothroyd,McGrawHill

REFERENCE BOOKS:

1. **Manufacturing Science**: Amitabha Ghosh and Mallik, Affiliated East Westpress,
2. **Metal cutting principles:** M.C. Shaw, MIT press Cambridge, Massachusetts,1996.
3. **Manufacturing Technology:** Vol.-I, P. Radha Krishnan, Sceitch Publications,Chennai
4. **Introduction to manufacturing processes:** John A. Schey – McGrawHill
5. **Elements of manufacturing process**: B.S. Nagendra Parashar and R.K. Mittal – Prentice HallIndia,
6. **Metal cutting and tool design**: Dr. B.J. Ranganath – VikasPublications.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**METAL CUTTING & MACHINE TOOLS LAB , IP430L**
No. of Teaching Hours – 39	**Credits :0:0:1.5**

Course Outcome:

On successful completion of the course the student will able to

1. Prepare Models using lathe involving plain, taper and step turning, thread cutting, eccentric turning and understand the acceptance criteria oflathe
2. Prepare the models using shaping machine and understand the acceptance criteria of a shapingmachine
3. Demonstrate the types of operations like groove and gear cutting using milling machine and understand the concept of indexing and understand the acceptance criteria of Milling Machine.
4. Perform experiments to measure the various forces acting on themachines.

Chapter No.	**Topics**	**Hrs**
01	Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.	18 Hrs
02	Cutting of V Groove / Rectangular groove using a shaper.	12 Hrs
03	Lathe, Shaper and Milling Machine Acceptance Test	03 Hrs
04	Measurement of Forces in Lathe, Milling Machine & Drilling Machine using cutting tool dynamometer	03 Hrs
05	Cutting gear teeth using Column & Knee Milling Machine using indexing method	03 Hrs

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Department of Industrial & Production Engineering, SJCE, Mysore

Subject Name & Code	**THERMALENGINEERING IP440**
No. of Teaching Hours – 52	**Credits : 4:0:0**

Course Outcome:

On successful completion of the course, the students will be able to:

1. Understand the basic concepts of Thermodynamics and to apply the principles of first and second laws ofThermodynamics.
2. Understand the principles prevailing in perfect gases and to study the various characteristics of different thermodynamicprocesses.
3. Explain the working principles of air compressors with numericalproblems.
4. Understand and evaluate the air standard and vapour power cycles with numerical examples.
5. Understand the working principles of steam nozzles and basics of heattransfer.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Basic concepts:** Systems surroundings, Universe, properties of system. First Law of thermodynamics: Internal Energy and Enthalpy, Problems	**05 Hrs.**
02	**Second law of Thermodynamics:** Heat engines and Heat pump. Efficiency and co-efficient of performance. Reversible and irreversible process, entropy.	**05 Hrs.**
	UNIT II	
03	**Perfect gases:** Characteristic equation specific heat of perfect gases, The universal gas constant. Pure substance properties – temperature of saturation. Enthalpy, dryness fraction, specific volume, latent heat, entropy, with reference to a pure substance such as water and its vapour. Super heatedvapour, Steam tables and Mollier diagram. Determination of dryness fraction of steam, Heating process of pure substances: constant volume, constant pressure, Isothermal, Hyperbolic, Adiabatic, Polytrophic and Throttling process, Problems	**10 Hrs.**
	UNIT III	
04	**Air compressors -** Reciprocating and rotary compression, work of compression for single stage and multistage compression. Effect of clearness volume on the performance of reciprocating compressors, Problems	**10 Hrs**

	UNIT IV	
05	**Air Standard cycles:** Derivations ofCarnot,Otto, diesel, Dual combustion, Brayton cycles, Numerical Problems	**06 Hrs**
06	**Vapour power cycles**: Carnot, Rankine cycle, Regenerative and Reheat cycles, Refrigeration Cycle: Refrigeration by non-cyclic Processes, Vapour compression refrigeration cycle, Absorption refrigeration Cycle- Numerical Problems	**06 Hrs**
	UNIT V	
07	**Steam Nozzles:** Velocity of steam flowing through a nozzle, effect friction, and conditions for maximum discharge through a nozzle. Supersaturated flow of Steam- Numerical Problems	**06 Hrs**
08	**Basic concepts of heat transfer:** Heat conduction, convection heat transfer, overall heat transfer coefficient, Radiation heat transfer, Thermal insulation	**04 Hrs**

TEXT BOOKS :

1. **Basic and applied thermodynamics** – P.K. Nag , Tata McgrawhillPublications
2. **Engineering Thermodynamics with applications** – David Burgardt
3. **Applied Engineering Thermodynamics** – Estop – LongmanPublication

REFERENCE BOOKS:

1. **Thermodynamics by VAN WYLEN & R.E Sontang WileyEastern**
2. **Thermodynamics by GUPTHA &Rajendraprakash**
3. **Thermodynamics & Heat Engines byDomkundwar**
4. **Thermodynamics worked examples – Y.A.C. Rao, IITDelhi**
5. **Thermodynamics – R.C. Patel**
6. **Thermodynamics – Arora IIT Delhi Tata Mcgrawhill Publication DATA**

HAND BOOK:

1. **Thermodynamic data hand book, B.T.Nijaguna.**
2. **Properties of Refrigerant & Psychometric (tables & Charts in SI Units), Dr. S.S. Banwait, Dr. S.C. Laroiya, Birla Pub. Pvt. Ltd., Delhi,2008**

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JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject name & code	**COMPUTER AIDED DESIGN IP450**
No. of teaching hours = 40 Hrs	**Credits :3-0-0**

Course Outcome:

On successful completion of the course the student will able to

1. Understand the basic concepts of CAD and CAD in computerized environment and hardware of computers.
2. Understand the principles of choosing right computer graphics configurations and its specifications and apply the concepts of B-rep and C-rep in wireframe and solid modelling.
3. Explain the concepts of assembly design and its pros and cons from the practical perspectives.
4. Understand and evaluate the application of the use of various interchange formats in order to transfer the files from one software to another.
5. Understand the working principles of CAPP and CAI.

Chap No.	**Topics**	**Hrs**
	Unit I	
1	**Introduction**: Role of computers in design and manufacturing, Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. The role of CAD in Product Life Cycle Management	03
2	**Hardware for CAD**: Usage and types of hardware for CAD – input devices, display devices, printing , plotting devices and other hardware interface devices	05
	Unit II	
3	**Computer graphics**: Software configuration of a graphic system, functions of a graphic package, construction geometry, wire frame and solid modeling, 2D linear, rotational , Transformations problems.	04
4	**Geometric Modeling:** Functions of geometric modeling, properties of geometric modeling, concept of Bezier curve, Constraint Based Modeling. **Solid modeling techniques** : Brief history of solid modeling, **CSG** – primitives, Boolean operations, modeling, B-rep – face, edge & vertex representations, topological considerations, manifold & non-manifold solids, Sweep representations. modeling, viewingfeatures.	04

	Unit III	
5	**Theory of Assembly design:** Basic concepts, Boolean operations in Assembly practice, part models, subassembly, relationships, associatively, constraints, manipulations, Assembly drawings, Part-listing, motions & DOF, determining material properties. Use of Model Tree, Parent-Child relationships, re-order synchronous modeling features,	08
	Unit IV	
6	**Automotive Design:** Using tab surface, ruled surface and other surface modeling techniques	04
7	**Exchange of modeling data**- Transition from drafting to designing with examples and discussions of basic features of IGES, STEP, DXF, DMIS and its applications	04
	Unit V	
8	**Computer Aided Process Planning :** Role of process planning in CAD/CAM Integration, Development, Benefits, Model and Architecture , CAPP Approaches - Variant, Generative and Hybrid Process Planning systems, Criteria in selecting a CAPP System.	04
9	**Computer Aided Inspection:** Engineering Tolerances, Need for Tolerances, Conventional Tolerances, FITS and LIMITS, Tolerance Accumulation and Surface quality, Geometric Tolerances, Tolerances Practices in design, Drafting and manufacturing, Tolerance Analysis , Tolerance synthesis	04

TEXT/REFERENCE BOOKS –

1. **CAD/CAM principles and applications by P NRao**
2. **CAD/CAM by Groover,**
3. **Introduction to design & analysis of algorithms - S.E.Goodman,S.T.Headetmiemi**
4. **Principles of interactive computer graphics by Newman &Sproul**
5. **Computer graphics by StevenHarrington**
6. **CAD-CAM by ChrisMcMahon& JimmieBrowne**
7. **CAD-CAM by IbrahimZeid**

Any other reference material like manufacturer's catalogues, journals etc.,

Competencies: Capability to perform product design functions by effective application of principles of CAD.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject name & code	**COMPUTER AIDED DESIGN LAB IP450 L**
Credits:0-0-1.5	**Total Marks –39**

Course Outcome:

On successful completion of the course the student will able to

1. Use computer packages to apply knowledge toreality
2. Develop Modelling applications for various primitiveobjects.
3. Apply the various commands like Model Tree, Reorder and otherfeatures
4. Apply the surface modelingfeatures
5. Apply the various assemblytechniques

Chap No.	**Topics**	**Hrs**
	IP450 LAB SESSIONS	
1	**Solid Modelling of simple machine components using CAD packages**: Suggested Software Packages like **UGS/NX** /CATIA or any other similar packages – Exercises, Basic Assembly Exercises	21
2	**Surface Modelling using CAD packages**: Suggested Software Packages like **UGS/NX** /CATIA or any other similar packages, Exercises	18

TEXT/REFERENCE BOOKS –

1. **CAD/CAM principles and applications by P NRao**
2. **CAD/CAM by Groover,**
3. **Introduction to design & analysis of algorithms - S.E.Goodman,S.T.Headetmiemi**
4. **Principles of interactive computer graphics by Newman &Sproul**
5. **CAD-CAM by ChrisMcMahon& JimmieBrowne**
6. **CAD-CAM by IbrahimZeid**

Any other reference material like manufacturer's catalogues, journals etc.,

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
V SEMESTER

Subject Name & Code	MANAGEMENT & ENTREPRENEURSHIP IP510
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective: The topic discusses the concepts of Management. It discusses the concepts of starting an organization, different types of companies. The main objective is to bring an awareness of various Principles of management like planning, organizing, staffing, controlling & leading followed by the industries. By this course, a student should diagnose a firms competitive situation based on real world situations and implement entrepreneurial knowledge to overcome various short range and long range problems.

Course outcome:

On successful completion of the course the student will able to,

1. Understand the meaning , nature, levels and characteristics ofmanagement.
2. Understand the nature , types, purpose of planning and taking decision under differentconditions.
3. Define the different organization structures and staffing policies andprocedures.
4. Demonstrate the motivation theories and techniquesapplied.
5. Define the entrepreneurship process , its evolution and barriers inentrepreneurship.
6. Prepare the project report and understand the importance of small scaleindustries

Chap No.	Topics	Hrs
	UNIT I	
01	Introduction: Historical perspective, contributions of F.W. Taylor‘s and Henry Fayol‘s Principles to the evolution of management as scientific discipline, Gantt‘s contribution to the management	02 Hrs.
02	Ownership of Industries: Proprietorship – Formation, advantages and limitations , Partnership – Formation, types of partnership, formation of partnership deed- rules, Limited liability partnership, advantages and limitations, Joint stock company- Formation, types of joint stock companies- private, public & Joint sector companies, Registered and unregistered companies, advantages and limitations, Co-operative societies –Formation, types, advantages and limitations	08 Hrs
	UNIT II	
03	Planning: Definition, types of plans, corporate objectives, policies, strategies, need for planning, responsibilities, and selection of alternatives and process of decision making.	05 Hrs
04	Organizing: Definition, types of organizations – Line, Line & Staff, functional and Matrix organization, authority and responsibilities, basic requirement, merits and demerits, Departmentation , vertical and horizontal growth, span of control – graicunas theory,narrow and wider span of control, centralization and decentralization, formal and informal organizations, skills of a manager at various levels in the organization	05 Hrs
	UNIT III	

05	Staffing: Appraisal of needs, Recruitment, selection, induction, orientation and placement, training – types of training, executive development, performance appraisal, methods of performance appraisal and its applications, case studies	12 Hrs
	UNIT IV	
06	Entrepreneurship: Meaning of Entrepreneur, Evolution of the concept, functions ofan entrepreneur, types of entrepreneur, Development, steps, role of entrepreneur, entrepreneurship in India, Entrepreneurship and its barriers.	05 Hrs
07	Small Scale Industry: Definition, characteristics, need, objectives, scope, role of SSI in economic development, ancillary industry, tiny industry (Definition only),	05 Hrs
	UNIT V	
08	Basic Principles and Acquisition of Intellectual Property Rights: Philosophical Aspects of Intellectual Property Laws, Basic Principles of Patent Law, Patent Application procedure, copyrights, trademarks.	10 Hrs

TEXT BOOKS:

1. Industrial Management- Banga&Sharma
2. Industrial Management and EntrepreneurshIP – Dr. N.V.R.Naidu
3. Industrial management –Tarachand
4. Hersey Pauland KennethH, -ManagementofOrganizationalBehaviourll, PHI.
5. Intellectual property rights: PrabuddhaGanguli TMH publishing co.ltd.,
6. Intellectual Property Law Handbook: Dr. B.L. Wadehhra, Universal Law publishing Co.Ltd.,

REFERENCE BOOKS:

1 Koontz Odonnel,-Principlesof Managementll, McGraw HillIntl.BookCo.
2 Koontz Weirich, -Essentialsof Managementll, TATA McGrawHillIntl. BookCo
3 McGreggar Douglas,-TheHuman Side of Enterprisell, McGraw HillIntl. BookCo.
4 Intellectual property law (Bare acts with short comments), Universal Law publishing Co.Ltd.,
5 Patents: Fundamentals for scientists and Engineers, Thomas T Gordon and Arthur S Cook fair, CRC press

JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	DESIGN OF MACHINE ELEMENTS – IP520
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objectives:

To understand and identify different types of loadings and stresses, to analyze and design machine components subjected to static, impact and fatigue loads and to design keys, cotter and knuckle joints, threaded fasteners, power screws, riveted and welded joints.

On successful completion of the course the student will able to Apply Mathematics, Science and Engineering knowledge to

Course Outcomes:

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

CO1: define and explain the various phases in design process, standardization and manufacturing considerations in machine parts, theories of failure and stress concentration, S-N diagram, Soderberg equation etc.

CO2: apply the knowledge to determine the maximum stress induced/size of the components subjected to static, Impact and fatigue loads.

CO3: analyze the machine elements subjected to static, impact and fatigue loads.

CO4: design basic machine elements like screwed fasteners, power screws, riveted and welded joints.

.Chap. No.	Topics	Hrs
	UNIT I	
01 02	Introduction: Definitions: Normal, Shear, Biaxial and Tri Axial Stresses, Stress Tensor, Principal Stresses. Engineering Materials and their Mechanical properties, Stress-Strain diagrams, Stress Analysis, Design considerations: Codes and Standards Manufacturing considerations in design of machine parts. Design for manufacture and assembly. Selections of fits, tolerences and manufacturing methods ,Selective assembly	04 Hrs.
03	Design for Static Strength: Static loads and Factor of Safety, Theories of failure. Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory; Failure of Brittle Materials, Failure of Ductile Materials. Stress Concentration, Determination of Stress Concentration Factor.	08 Hrs
	UNIT II	
04	Design for Impact Strength: Introduction, Impact Stresses due to Axial, Bending and Torsional loads, Effect of Inertia.	03 Hrs
05	Design for Fatigue Strength: Introduction- S-N Diagram, Low Cycle Fatigue, High Cycle Fatigue, Endurance Limit, Endurance Limit. Modifying Factors: Size effect, Surface effect, Stress Concentration effects. Fluctuating Stresses, Goodman and Soderberg relationship; Stresses due to Combined Loading, Cumulative Fatigue Damage.	07 Hrs

	UNIT III	
06	Fasteners: Keys, types of keys, stresses in keys, design of keys and splines, Bolts nuts and screws-Stresses in screw fastening, initial stresses, stresses due to external forces, stresses due to combined load, bolts and of uniform strength, bolt subjected to shear, bolts under excentric loading, torque requirement for bolt tightening, design of turn buckles, bolted joints under fluctuating loads.	10 Hrs
	UNIT IV	
07	Power Screws: Mechanics of Power Screw, Stresses in Power Screws, Efficiency and Self-locking, Design of Power Screw, Design of Screw Jack: (Complete Design). Differential and compound screws. Recerculating ball screws	10 Hrs
	UNIT V	
08	Mechanical Joints: Socket and spigot cotter joints, sleeve and cotter joint, knuckle joint. Riveted joints :Types, Rivet Materials, Failures of Riveted Joints, Joint Efficiency, Boiler Joints, Tank and Structural Joints, Riveted Brackets. Welded Joints: Types, Strength of Butt and Fillet welds, axially loaded unsymmetrical welded sections, Eccentrically loaded Welded Joints.	10 Hrs

DESIGN DATA HAND BOOKS:

1. Design Data Hand Book – K. Lingaiah, McGrawHill,.
2. Design Data Hand Book – K. Mahadevan and Balaveera Reddy, CBSPublication
3. Machine Design Data Hand Book – H.G. Patil, Shri ShashiPrakashan,Belgaum.
4. PSG Design Data Handbook PSG College of Technology,Coimbatore.

TEXT BOOKS:

1. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke. McGraw Hill Internationaledition,
2. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi,

REFERENCE BOOKS:

1. Machine Design: Robert L. Norton, Pearson EducationAsia,
2. Design of Machine Elements: M. F.Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, PearsonEducation,
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special IndianEdition,
4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., NewDelhi
5. Elements of Machine Design: N.C Pandey & C.S. Shah Chorotar Pub Anand (Gujarat)India.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	PRODUCT DESIGN AND MANUFACTURING- IP530
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objectives:

The objective of the course is to make students to understand and apply the concepts of Need Identification, Problem Definition, Product Planning and Design, Applying suitable manufacturing processes, Optimization and feasibility of the product, Consideration of Human Factors and Environmental Sustainability in the Product Design. Students will learn the concepts using real life Product design case examples and hands-on projects based on the concepts studied in the course.

Course Outcomes: On successful completion of the course the students will be in a position:

1. To be aware of the role of multiple functions in creating a new product and Confidence in evaluation and searching of design needs.
2. To understand the customer needs and converting the need into relevant product concepts and arriving at effective cost design with the help of value engineering.
3. To be able to co-ordinate multiple, inter-disciplinary tasks in order to achieve a common objective in the selection of manufacturing processes.
4. To develop techniques for testing of quality, ergonomic and reliability features with suitable case examples.
5. To understand human consideration in applying concepts in product design and development of product with emphasis on the environmental sustainability.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Designing, distinction between Engineering and Design, Traditional Designer. Design by Evaluation, Morphology of Design, Customer Need Identification and Problem Definition, Analysis of need, need statement, Engineering design process and its structure. Production- Consumption Cycle, Product design specifications.Morphological analysis, brainstorming. Evaluation ofDesignconceptsforFeasibility study. Case studies.	11 Hrs.
	UNIT II	
02	Generation of Concepts, preamble on creativity & its barriers, Innovation & Brainstorming, Preliminary product design, Product Planning, Resource allocation and Plan timing, Value Engineering Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Normal Degree of Value, Importance of Value, The Value analysis Job Plan, Steps to Problems-solving and Value Analysis, Value Engineering Idea Generation Check-list CostReduction through value engineering, case studies.	12 Hrs
	UNIT III	

03	Selection of Manufacturing Processes:Review of Manufacturing Processes, Design for Casting, Bulk Deformation Processes, Sheet Metal Forming Processes, metalmachining, powder metallurgy, material and processes, case studies. Welding, brazing, soldering, adhesive bonding, designing with Plastics, Rubber, Wood and other materials.	10 Hrs
	UNIT IV	
04	Design for Reliability and Quality,Approach to Robust Design, Modern Approaches toProduct Design, Role of Computer in manufacturing. Design for optimization Quality Function Deployment (QFD).Economic Factor Influencing Design: Product Value, Design for Safety, Reliability, and Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break – even Analysis, Economic of a New Product Design.	09 Hrs
	UNIT V	
05	Human Factors in Product Design: Product Design considerations in Ergonomics, Human being as Applicator of Forces, Anthropometry; Man as occupant of Space, The DesignofControls,ofcontrols,theDesignofDisplays,Man/MachineInformation Exchange. Modern approaches to product Design. Product design for environment. Environmental factors, guidelines & Techniques.	10 Hrs

TEXT BOOKS:

1. Product Design and Manufacturing, A.C. Chitale and R.C. Gupta,PHI Sixth edition.
2. ProductDesign&Development,KarlT.Ulrich&StevenD,Epinger,TataMc.GrawHill, Fifth Edition.

REFERENCEBOOKS:

1. New Product Development, Tim Jones, ButterworhHeinmann, Oxford,mc.
2. New Product Development: Design & Analysis by Roland EngeneKinetovicz, John Wiley and SosnInc.,N.Y.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	INDUSTRIAL ENGINEERING & ERGONOMICSIP540
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective:

1. To Provide thebasicknowledge of productivity and method study in various sectors and its effectiveness in improvement ofproductivity
2. To provide the usage of the various tools and techniques used in workmeasurement.
3. To compare and study of the existing system and propose a newmethod
4. To develop an idea for ergonomically based design for Human MachineSystem.

Course Outcome:

On successful completion of the course the student will able to

1. Recollect the basic concepts of productivity, work content and workstudy
2. Define the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessarymovements.
3. Explain the basic work measurement techniques and to gain knowledge of measurement of work and understand the importance of time study and demonstrate the rating techniques and the principlesinvolved.
4. Demonstrate the basic concepts of ergonomics and study the components of man-machine systems.
5. Design the displays and controls of machines and able to understand the effect of environmental factors on humanefficiency.

Chap. No.	Topics	Hrs
	UNIT I	
01	Productivity Definition of productivity, task of management. Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programmes	05 Hrs.
02	Work Study:Definition, objective and scope of work study. Human factors in work study. Work study as applied to the top management, supervisors and the worker.	05 Hrs
	UNIT II	
03	Method Study: Definition, objective and scope of method study, activity recording and exam aids. Outline process charts, flow process charts, travel chart.	04 Hrs
04	Multiple activity charts: Charts to record movement at work place - principles of motion economy, classification of movements, two handed process chart, SIMO chart, spaghetti diagram and other important micro motion studies.	06 Hrs

UNIT III		
05	Work Measurements: Definition, objectives and benefit of work measurement. Work measurement techniques. Work sampling – need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.	05 Hrs
06	Time study: - Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.	07 Hrs
UNIT IV		
07	Predetermined motion time study: Method Time Measurement (MTM)	04 Hrs
08	Ergonomics: Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and theirfunctions-workcapabilitiesofindustrialworker,studyofdevelopmentofstressin human body and their consequences.	06 Hrs
UNIT V		
09	Design of Man-Machine System: Fatigue in Industrial workers. Quantitative, qualitative representation and alphanumeric displays. Controls and their design criteria, control types, relation between controls and displays, layouts of panels and machines.	05 Hrs
10	Design of work place: Value Stream Mapping in optimizing the layout, influence of climate on human efficiency, influence of noise, vibration and light.	05 Hrs

TEXT BOOKS :

1. Introduction to Work Study – ILO, RecentEdition,
2. Barnes,-Motion andTime StudyII,

WileyInternationalREFERENCEBOOKS:

1 M.S.SundersandE.J.Mckmic,-HumanFactorsinEngineeringDesignII,RecentEdition,McGrawHill
2 S. Dalelaand Sourabh, -Work Studyand ErgonomicsII.
3 Kharger and Bahya; Engineered work measurement, Weldon,ELBS

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	INDUSTRIAL ENGINEERING & ERGONOMICS LAB IP540L
No. of Teaching Hours – 39	Credits :0:0:1.5

Courseobjective:

Students will learn work-study, method study and work measurement techniques and plot the respectivecharts.

CourseOutcome:

On successful completion of the course the student will able to

1. Recall basic concepts of methodsstudy.
2. Define and analyze the parameters of 2 handed processcharts.
3. Construct various charts, analyze and propose a newmethod.
4. Demonstratesavingsintime,labourwhichwillresultinremovalofunnecessarymovementsusing time studycharts
5. Determine the rating factors and understand the use of the TMT & PMTStechniques.

Chap. No.	Topics	Hrs
01	To study of the existing method of assembly of a component with the layout as given and a. Prepare the operation processchart. b. Prepare the two-hand processchart. c. Draw the learningcurve. d. Determine the cycle time from the sufficient number ofobservations	09 Hrs
02	For the operation in experiment no 1, Develop a new method, prepare improved new two handed process chart and calculate cycle time	06 Hrs
03	Experiments using the following experiments on Method Study: Outline process chart, Flow process chart, Flow diagram – String Diagram, Multiple activity chart, MTM II Chart, Two handed process charts, Kanban	09 Hrs.
04	Experiments using the following experiments on Time Study – Marble experiments, nut and bolt assembly, operating the mechanisms and other related case studies, pokayoke concepts. Rating exercises	06 Hrs
05	Experiment on Ergonomics using Ergo meter and Tread mill- TMT test Determining the standard time and PMTS (Study & analysis)	06 Hrs
06	Case examples from Journals and other sources	03 Hrs

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	TECHNICAL COMMUNICATION & PROFESSIONAL ETHICS HU550
No. of Teaching Hours – 42 + 28	Credits : 4:0:0

After completing this course the student should be able to

CO-1 Write effective technical documents by applying recommendedpractices.
CO-2 Communicate formally using emails and letters, prepare presentation slides,resume and statement ofpurpose.
CO-3 Take part effectively in interviews and group communicationactivities.
CO-4 Describe the characteristics of engineering profession, professional responsibility, reporting and rules ofpractice.
CO-5 Describe ethical aspects of engineeringprofession.

Chap. No.	Topics	Hrs
	UNIT I	
01	Effective Technical Communication: Principles of scientific vocabulary.Techniques of sentence and paragraph construction.Writing scientific and engineering papers. Elements of page layout and typography and proof reading.Effective use of charts, graphs, and tables.Writing technical reports.Precis of science and engineering-related topics. Speech communication: Effective Presentation Techniques. The role of e-mail in the communication process. Observing the Code of Gender Neutral Language. Avoiding plagiarism. Preparation of resume and statement of purpose.	18 Hrs.
	UNIT II	
02	Interviews and Group Communication: Objectives of interviews.Types of interviews.Job interview types–campus interviews,on-site interviews, telephonic interviews. Tips for successful participation in job interviews. Forms of group communication – meetings, seminar, group discussions, symposiums, conferences. Tips for successful participation in group communication.	08 Hrs
	UNIT III	
03	Introduction to Engineering Profession: Characteristics of a profession. The engineering profession. Licence.Professionalresponsibility.The Engineer‘s Duty to Report. Rules of Practice.Use of the Professional Engineers Seal.Relations with Client or Employer.Due Diligence. Professional Engineering Bodies in India.	08 Hrs
	UNIT IV	

04	Ethics of Engineering Profession: Professional Standards. Practice Guidelines. Professional Misconduct. Code of Ethics for the Profession. Professional code set forth by The Institution of Engineers, India. Report Writing.GivingOptions.Communications.RetainingDocuments. Confidential Information.Volunteering.Data Gathering at the Beginning of a Project. Conflicts of Interest.Certificate of Authorization.	08 Hrs

References

NOTE: Specific text book/s to be followed topic-wise will be prescribed by the teacher.

Course Materials.

1. ProfessionalEngineeringPractice:ProfessionalEngineersOntario,101-40SheppardAv-enueWestToronto ONM2N6K9.
2. Caroline Whitebeck, -Ethicsin Engineering Practice and ResearchII, CambridgeUniver-sityPress,
3. PhilipKosky,et.al.-Exploring Engineering:An Introduction to EngineeringandDe-signII, AcademicPress/Elsevier,2010.
4. BarunK. Mitra, -EffectiveTechnicalCommunicationII, 1st Edition, 9thImprint, Oxford UniversityPress,
5. MeenakshiRamanet.al., -TechnicalCommunication:Principlesand PracticeII, Oxford UniversityPress,
6. Principles of Engineering Practice - MIT Open CourseWare.
7. BeamerDocumentClassUserGuideavailableathttp://tug.ctan.org/macros/ latex/contrib/beamer/doc/beameruserguide.pdf

Lab Exercises

Note: The exercises given below may require more than one lab session. So, the evaluation of lab work will be based only on the quality of thefinal output in respect of the exercises given below.

1. Write a formal email introducing your self with a request for internship in the domain of your interest and send it to your facultyemailID.
2. UsingLATEXandassociatedsoftwarelikeTexmakerand/orLyX,andInkscape(forcreating line drawings), create the followingdocuments–
   a) A formal letter to an industry requesting for aninternship.
   b) Slides for a technical talk of about30min duration on the subject allotted to you byfaculty.
   c) A Journal paper (an available paper can berecreated).
   d) A template for your final year projectreport.
   e) A lab experimentreport.
3. Usingawordprocessor,writeyourStatementofPurpose,assumingthatyouareapplyingforyour M.S. program in a foreign university.
4. Using a wordprocessor, prepare your resume and a covering letter, assuming that you are applying for a post in a privatecompany.
5. Using Google Docs, repeat Exercises 2 and 3 givenabove.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	MAINTENANCE ENGINEERING & INDUSTRIAL SAFETY IP561 ELECTIVE I
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective:

Students understand the basics of maintenance and learn the management behind technology implementation.

Course Outcome:

On successful completion of the course the student will able to

1. Recall basic concepts of maintenanceengineering
2. Define the maintenance planning & machinery and discuss its evaluation andcontrol
3. Explain the Analysis for economics and computers inmaintenance.
4. Demonstrate the safety skills and standards in implementing change and scope of productivity improvements
5. Learn adoption of total productive maintenance and pollution control and other maintenance concepts from the industryperspective.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction to Maintenance System**:** Definition, Scope, Objective, functions and Importance of maintenance system, Type of maintenance system, Break down maintenance system, Preventive maintenance, Predictive maintenance, design out maintenance, corrective maintenance, planned maintenance, total productive maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance.	10 Hrs
	UNITII	
02	Maintenance Planning**:** Planning of maintenance junctures manpower allocation, Long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control.	06 Hrs
03	Maintenance of Machinery**:** Causes of machine failure, performance evaluation, completeoverhaulingofMachinestools.Maintenanceplanningandscheduling.Repair order control manpower requirement, Maintenance job analysis spare parts control.	06 Hrs
	UNIT III	
04	Economics in Maintenance**:** Repair, replacement, Repair complexity, Finding out most optimal preventive maintenance frequency. Numerical treatment required.	06 Hrs
05	Computers in Maintenance**:** Features and benefits of Computer aided maintenance. Application of computers to maintenance work.	04 Hrs

UNIT IV		
06	Industrial Safety: Economic importance of accidents, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety standards for Mechanical equipment.	05 Hrs
07	Safety Standards: Safety standards for Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, welding, Plant housekeeping-building, Aisles, passages, floors, tool cribs, washrooms, canteens.	05 Hrs
UNIT V		
08	Total Productive Maintenance: Introduction, The Plan, Learning the New Philosophy, Promoting the Philosophy, Concept of Terro technology, Autonomous work groups, and application.	05 Hrs
09	Industrial Pollution Control: Dust control –Fibre collectors, mechanical dust collectors, wettypecollectors,Electrostaticprecipitators,NoisepollutionControl–Noise measurement and control. Industrial vibration and its control, applications of IPC.	05 Hrs

TEXT BOOKS:

1. Maintenance Engineering and Management - R.C.Mishra and K.Pathak, Prentice Hall of India, 2002
2. Maintenance Engineering Hand book -Morrow.

REFERENCE BOOKS:

1. Hand book of Maintenance Management - FrankHerbaty
2. Hand book of Industrial Engg & Management - W. Grant Lreson& EugeneL-Grant
3. Industrial Pollution Control Handbook -LUND
4. Industrial Maintenance - H PGarg
5. Maintenance Engineering Hand book - Lindrey Higgins, McGrawHill,
6. Plant Engineering Hand book –Staniar

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	THEORY OF METAL FORMING - IP562
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective:

To learn the basic concepts of plasticity, forming process, lubrication, rolling and extrusion of different metals and their alloys

Course Outcome:

On successful completion of the course the student will able to

1. Understand the concepts of Theory of Plasticity and Von Mises criterion and Tresca criterion and learn the effects of these parameters on variousmaterials
2. Demonstrate the concept, types, forces and defects of Forging and rolling ofMetals
3. Understand and analyze metal forming principles in the Extrusion and Drawing ofmetals.
4. Understand the criticality and working of Sheet metal formingprocesses
5. Understand and apply the concepts of metal forming in the field of high energy rate forming methods and powder metallurgy with suitable illustrativeexamples.

Chap. No.	Topics	Hrs
	UNIT I	
01	INTRODUCTION AND CONCEPTS: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, triaxial& biaxial stresses. Determination offlowstress.Principalstresses,Tresca&Von-Misesyieldcriteria,conceptsofplane stress& plane strain. Simple problems	06 Hrs.
02	EFFECTS OF PARAMETERS: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.	06 Hrs
	UNIT II	
03	FORGING: Classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it. Die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging.	06 Hrs
04	ROLLING: Classification of Rolling processes. Types of rolling mills, expression for Rolling load. Roll separating force. Frictional losses in bearing, power required in rolling, Effects of front & back tensions, friction, friction hill. Maximum possible reduction. Defects in rolled products. Rolling variables.	06 Hrs

	UNIT III	
05	DRAWING: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing, classification of tube drawing.	06 Hrs
06	EXTRUSION: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, Extrusion of seamless tubes. Extrusion variables and simple problems	06 Hrs
	UNIT IV	
07	SHEET & METAL FORMING: Forming methods, dies & punches, progressive die, compound die, combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, Forminglimit criterion, defects of drawn products, stretch forming. Roll bending & contouring,	08 Hrs
	UNIT V	
08	HIGH ENERGY RATE FORMING METHODS: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming. POWDER METALLURGY: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantagesand limitations.	08 Hrs

TEXT BOOKS:

1. Mechanical metallurgy (SI units), G.E. Dieter, McGrawHill
2. Manufacturing Process – III, Dr. K.Radhakrishna, Sapna BookHouse

REFERENCE BOOKS:

1. Materials and Processes in Manufacturing,E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall ofIndia
2. Principles of Industrial metal working process, G.W. Rowe,CBSpub.
3. Manufacturing Science,AmitabhaGhosh& A.K. Malik - East-Westpress
4. Technology of Metal Forming Process, Surendrakumar,PHI

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	MARKETING MANAGEMENT IP563 ELECTIVE I
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective:

This course provides an introduction to the fundamentals of marketing management. Basic marketing concepts and elements of marketing practice. Emphasis will be on the managerial aspects of marketing plans,including analysis of the external environment.

Course Outcome: *Upon successful completion of this course, students should be able to :*

1. Understand the general concepts about marketing management, marketing process, consumer andbuyerbehaviormodelswithcaseexamplesandapplytheseskillsinsolvingreallifeproblems
2. Understand the roles of segmentation, targeting and positioning as part of a comprehensive marketing research and marketing information systems with the help of suitable industry, white paperexamples.
3. Apply the concepts of product line, product mix, product life cycle stages for suitable launching of new products and to arrive at feasibility of themarkets.
4. Understand the concepts of branding, labeling and packaging. Apply the knowledge of patent, copyrights for its effectiveimplementation,
5. Understand the concepts of pricing, advertising and sales promotion. Understand and apply these concepts with the help of case studies and whitepapers.

Chap. No.	Topics	Hrs
	UNIT I	
01	Market, Marketing and Marketing Management: Introduction: Historical development marketing management, tasks and philosophies, modern marketing concepts, importance of marketing in the India Socio – economic system. Marketing System- Company marketing system – levels in marketing environment of a company, marketing process, marketing mix, and marketing strategy.	04 Hrs.
02	Consumer Markets and Buying Behavior: Classification of consumer products, participants in the consumer buying decision, factors influencing consumer buying behaviour, characteristics influencing consumer behaviour, major stages in buying process.	06 Hrs
	UNIT II	
03	Marketing Information Systems and Research: Components of marketing information system. A sample case study towards establishing a Marketing information systems – benefits and uses marketing research system	05 Hrs

04	Marketing Research: Steps of marketing research, measurement of market demand. Types of Market Research, Feasibility study for a consumer product.	05 Hrs
	UNIT III	
05	Products Planning and Development: The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of -New – product; major stages in new – product development product life cycle.	10 Hrs
	UNIT IV	
06	Branding, Labeling, and Packaging: Branding Reasons for branding, functions of branding features of types of brands, kinds of brand name. Labeling - Types, functions advantages and disadvantages, Packaging- Meaning, growth of packaging, function of packaging, kinds of packaging, Copy rights and Trade Marks, Patents.	10 Hrs
	UNIT V	
08	Pricing and Distribution: Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions. Distribution - Marketing channels – functions, types of channels of distribution number of channel levels.	06 Hrs
09	Advertising and Sales Promotion: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion.	06 Hrs

TEXT BOOKS:

1. Philip Kotler -PrinciplesofMarketing‖, Prentice–Hall.
2. Philip Kotler -MarketingManagement‖, Prentice–Hall.
3. Michael R Czinkota, Marketing Management, Vikas PublishingHouse,

REFERENCEBOOKS:

1. WiliamJStannon, -Fundamentalsof Marketing‖, McGraw Hill
2. R.S.N. Pilliaand Mrs. Bagavathi-Marketing‖S. Chand& Co. Ltd
3. S.A Sherlaker, -Marketing Management‖
4. Rajagopal, marketing Management Text & Cases, Vikas Publishing House, ISBN 81-259-0773-4

JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	NON DESTRUCTIVE TESTING IP564 ELECTIVE I
No. of Teaching Hours – 52 Hrs	Credits : 4:0:0

Course objectives: Students will get an insight on different non-destructive testing techniques and application in various industries

Course Outcome:

Upon completing this course, the students should be able to:

1. Know the basic concepts of NDT and Detect discontinuities using magnetic particle inspection techniquesandUsetheprinciplesofeddycurrentinspectionforthedetectionofdiscontinuities.
2. Learn the concepts of ultrasonic inspection by different methods for the detection ofdefects.
3. Evaluate the defects using radiography and itstechniques
4. Understand the concepts of optical holography, eddy current inspection and tomography for the detection of defects by using differentmethods.
5. Understand and analyse recent NDT methods with the help of suitable caseexamples.

Chap No	Topics	Hrs
	UNIT I	
01	INTRODUCTION TO ND TESTING: Selection of ND methods, Scope and advantages of NDT. Comparison of NDT with DTSome common NDT methods used since ages, Flaws and Defects Terminology	02 Hrs.
02	Magnetic Particle Inspection: Methods of generating magnetic fields – types of magnetic particles and suspension liquids – steps in inspection – application and limitations. Eddy Current Inspection: Principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.	08 Hrs
	UNIT II	
02	ULTRA SONIC INSPECTION: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, Basic equipment characteristics of ultra sonic waves, variables in inspection, inspection methods – pulse echo A, B, C, scans, transmission, resonance techniques, transducer elements, couplets, search units, contact types and immersion types. CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.	10 Hrs.

	UNIT III	
03	RADIOGRAPHIC INSPECTION: Principles, radiation sources, x-rays andgamma rays: x-rays tubes, radio graphic films, screens and filters, image intensifiers, technique charts, industrial radiography, electro-radiography, image quality, radiographic sensitivity, electron neutron radiography. X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of y-ray radiography – principle, equipment. Attenuation of electro magnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of y-ray radiography overX-ray radiography Precautions against radiation hazards. Case Study — X-ray of human body	12 Hrs
	UNIT IV	
04	INDUSTRIAL COMPUTED TOMOGRAPHY: Basic principles, capabilities, and comparison with other NDE methods – application of ICT. Thermal inspection principles, equipment inspection methods applications.	06 Hrs
05	EDDY CURRENT INSPECTION Principle, Methods, Advantages, Scope and limitations. Types of Probes. Case Studies	06 Hrs
	UNIT V	
06	RECENT NDT METHODS Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglotest	08

TEXT BOOKS:

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing &Evaluation
2. Research Techniques in NDT Vol.3, R.S. Shah,Academic
3. Industrial Quality Control,Webstar
4. Bray,DonE.andStanley,RodericK.,NondestructiveEvaluation:AToolinDesign,Manufacturing, and Service., CRC Press NewYork.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject name & code No. of teaching hours - 39 Hrs	COMPUTER AIDED DESIGN & ANALYSIS LAB IP57 L Credits:0-0-1.5

Objective :Enable the students to understand the need of computer based design tools in PLM functions, Understand various roles of computers in computer aided design and analysis, Compare the conventional and computer integrated design functions, Integration of design and analysis functions using CAD/CAE applications and Appreciate the reduction in cycle time.

Course Outcome:

On successful completion of the course the student will able to use computer packages to apply knowledge to reality

1. Develop finite element analysis applications for various primitiveobjects.
2. Apply CAD and FEM principles to understand the practicalimplications

IP550 LAB SESSIONS		
1	Modelling and Simulation of Machining process of simple machine parts using CAM packages: Suggested Software Packages like UGS/NX /CATIA, MASTER CAM or any other similar packages. Surface Modelling : Exercises	21 Hrs
2	Analysis using Finite Element Analysis Packages like ANSYS, NX, NASTRAN: Linear analysis of1D, 2D, 3D Structural problems, Evaluation of displacement, Strain and Stress. Problems involving Beams and Trusses, shell, plates and solid elements, Contact problem, Dynamic Analysis of Fixed – fixed beam for natural frequency determination, Bar subjected to forcing function and Fixed – fixed beam subjected to forcing function and 2 examples of conduction and convection problemsand other related problems	18 Hrs

TEXT/REFERENCE BOOKS –

1. CAD/CAM principles and applications by P NRao
2. CAD/CAM byGroover,
3. Reddy. J.N., -An Introduction totheFinite ElementMethodII, 3rd Edition,Tata McGraw-Hill, 2005
4. Seshu, P,-Text Bookof Finite Element AnalysisII, Prentice-Hall of India Pvt. Ltd., New Delhi,2007.
5. Rao, S.S., -TheFiniteElement Method in EngineeringII,Butterworth Heinemann,

Any other reference material like manufacturer's catalogues, journalsetc.,

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

VI SEMESTER

Subject Name & Code	OPERATIONS RESEARCHIP610
No. of Teaching Hours – 52	Credits : 4:0:0

Objective: As a mathematical discipline, OR establishes theories and algorithms to model and solve optimization problems that translate to real life decision making problems. It enables the students with skills required for the application of a set of analytical tools used in decision making.

Course Outcome: On successful completion of the course the student will able to

1. Understand the basic concepts of operations research methodology and develop mathematical models for real world problems using linear programmingtechnique.
2. Formulate, analyze and optimize transportation and assignment model that deals with assigning sources and jobs to destinations andmachines.
3. Understand and apply the method of planning and controlling typical projects using PERT and CPM by developing interdependence network diagrams and optimizing them for different time estimates.
4. Construction of mathematical models for various types of queuing systems by optimizing manpower and other resources to improve theservice.
5. Understand and apply the foundation of rational decision making and model the real-world situations for strategicconsiderations.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Definition of OR, OR Phases, Features and Limitation of OR, Application of OR to Engineering and Managerial problems.	
02	Linear Programming: Definition, mathematical formulation, standard form, solution space, solution – feasible, basic feasible, optimal, infeasible, multiple, optimal, Redundancy, Degeneracy. Graphical solutions. Simplex methods: Variants of Simplex algorithms, Dual Simplex and Big M methods.	12
	UNIT II	
03	Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem. Degeneracy in transportation problems: Concept of Degeneracy and its application in Transportation problems.	12
04	Assignment Problems: Formulation, unbalanced assignment problem, and cases of traveling salesman problems.	
	UNIT III	

07 08	Project Management Using Network Analysis: Overview of Project management fundamentals, Network construction, CPM - Determination of critical path and duration, floats. Least cost project scheduling. Flow in networks: Determination of shortest route, Determination of Maximum flow through the networks, PERT- Estimation of project duration, types of estimation and calculation of variance. Concept of Crashing.	12 Hrs
	UNIT IV	
09	Queuing Theory: Queuing system and their characteristics. The M/M/I Queuing system, Steady state performance analyzing of M/M/1 and M/M/C queuing model	08 Hrs
	UNIT V	
10	Game Theory: Formulation of games, Two person–Zero sum game, games with and without saddle point, Graphical solution (2xn, mx2 game), and dominance property.	08 Hrs

TEXT BOOKS:

1. Taha H A - Operation Research and Introduction,McMillian.ISBN-0-02-418940-5
2. Philips, Ravindran and Soleberg-Principles of Operations Research-Theory and practice,PHI

REFERENCE BOOKS:

1. Hiller and Liberman, Introduction to Operation Research, McGraw Hill 5thedn
2. S.D. Sharma – Operations Research, Kedarnath, Ramnath&Co
3. J K Sharma, Operations Research Theory and Application, 2nd Edn,ISBN-0333-92394-4
4. Kanthiswarup& Others – Operations Research., Sultanch andSons

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	OPERATIONS RESEARCH & STATISTICS LAB IP610L
No. of Teaching Hours – 39	Credits : 0:0:1.5

Course Objective

Give students an exposure towards QSB, TORA, Workstudy Professional software and use of software packages to solve linear programming problems, plotting appropriate charts and diagrams relevant to various industrial applications.

Course Outcome

On successful completion of the course the student will able to

1. To implement practical cases of Operations Research and SQC by using TORA, QSB, and other Optimization software.

Chap No	Topics	Hrs
01	Use of Spreadsheet software for Statistical Analysis.	09 Hrs.
02	Study and analysis of the following methods of Operation Research using Operations Research Software 1. Linear ProgrammingModels. 2. TransportationModels. 3. AssignmentModels. 4. QueuingModels. 5. GameTheory.	18 Hrs
03	Study and analysis of Statistical Control using Quantitative Systems Software 6. RegressionAnalysis 7. X bar, RChart, 8. C Chart, 9. P Charts, 10. U chart and npcharts	12 Hrs

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	NON TRADITIONAL MACHINING – IP620
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective: The topic covers the machining of the materials by non-conventional means. The student will learn modern methods of manufacturing in the present context and learn the importance of these machine tools in the present context.

Course Outcome:

On successful completion of the course the student will able to

1. Understand the concept of conventional and non conventional machining processes and also study the concepts of unconventional machining as applied to ultrasonic machiningprocess,
2. Understand the concepts of unconventional machining as applied to Electro Chemical machining process and itstooling.
3. Understand the concepts of chemical machining and contourmachining
4. Understand the concepts of abrasive jet machining and plasma arc machining from the concept of unconventional machiningprocess
5. Explain the various aspects of Electric discharge machining(EDM) and itsapplications.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: History, Classification, comparison between conventional and non-conventional machining process selection.	03 Hrs.
02	Mechanical Process: Ultrasonic Machining (USM): Introduction, Equipment, tool materials & tool Size, Abrasive slurry, USM process Characteristics:-Material removal rate,toolwear,Accuracy,surfacefinish.,Applications,Advantages&Disadvantagesof USM	07 Hrs
	UNIT II	
03	Electrochemical Machining(ECM): Introduction, Study of ECM machine, Elements of ECM process:-Cathode tool, Anode work piece, source of DC power, Electrolyte. Chemistry of the process, ECM process characteristics-Material removal rate, Accuracy, Surface finish	06 Hrs
04	ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size,Handling of slug., Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations	06 Hrs
	UNIT III	
05	Chemical Machining (CHM): Introduction, Elements of process, Chemical blanking Process, Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, Accuracy of chemical blanking, Applications of chemical blanking.	06 Hrs

06	Chemical milling (Contour machining):- Process of steps-masking, Etching, process characteristics of CHM:- material removal rate. Features of Hydrogen embrittlement, Advantages & applications	04 Hrs
	UNIT IV	
06	Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM:- Carrier Gas, Type of abrasive, Size of abrasive grain, velocity of the abrasive jet, Work material, standoff distance(SOD), Nozzle design, Shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, Advantages & Disadvantages of AJM	06 Hrs
06	Plasma Arc Machining (PAM): Introduction, equipment non-thermal generation of plasma, selection of gas, Mechanism of Metal removal, PAM parameters, Process characteristics. Safety precautions, Applications, Advantages and limitations.	04 Hrs
	UNIT V	
07	Thermal Metal Removal Processes: Electrical discharge machining(EDM)-introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools(electrodes) Electrode feed control, Electrode manufacture, Electrode wear, Choice of machining operation, electrode material selection, under sizing and length of electrode, Machining time. Flushing-Pressure flushing, suction flushing, side flushing, EDM process characteristics: Metal removal rate, Accuracy surface finish, Heat affected Zone. Machine tool selection, Application: EDM accessories /applications,electrical discharge grinding, Travelling wire EDM.	10 Hrs

TEXT BOOKS :

1. Modern Machining Process- Pandey And Shah, Tata McgrawHill
2. New Technology -Bhattacharaya

REFERENCE BOOKS:

1. Production Technology - HMT TATA McGrawHill.
2. Production Technology -R.K.Jain
3. Production Technology -O.P.Khanna
4. Production Technology - AmitabhGhosh&Mallik

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	APPLIED MACHINE DESIGN IP 630
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective:

1. To understand design of shafts subjected to static loads, fluctuating loads and combinedloads.
2. To understand and design different types ofcouplings
3. To understand different types of springs and design of helical and leafsprings
4. To understand different types of clutches and design of plate clutches, coneclutches.
5. To understand different types of brakes and design of block brakes, bandbrakes
6. To understand different types of gears, terminology of gears, gear tooth failure and design of spur, helical , bevel and wormgears.
7. To understand different types of bearings, mechanism of fluid film lubrication, design of journal and rolling bearings.

Course Outcome:

CO1: Understand and explain ASME and BIS codes in shaft design, shafts subjected to combined loads, stresses in helical and leaf springs, gear tooth nomenclature, selection of right kind of gear, Lewis equation for static strength design in gears, mechanism of fluid film lubrication, sliding contact and rolling contact bearings

CO2: Apply the knowledge to determine suitable proportions for the shafts, springs, clutches, brakes, gears and bearings

CO3: Analyze shafts subjected to combined loads and fluctuating loads.

CO4: Design shafts, couplings,springs, clutches, brakes, gears and bearings.

Chap. No.	Topics	Hrs
	UNIT I	
01	Design Of Shafts & Couplings: Shafts: Torsion of Shafts, Design for strength and Rigidity with Steady loading, ASME & BIS codes for Power Transmission shafting, Shafts under Fluctuating loads and Combined loads.	07 Hrs
	Couplings: Rigid and Flexible Couplings: Flange Coupling, Bush and Pin type Coupling and Oldham's Coupling	03 Hrs
02	Design of Springs: Types of springs – stresses in Coil springs of circular and non- circular cross sections. Tension and compression springs, Fluctuating load, Leaf Springs : Stresses in Leaf springs. Equalized stresses – Energy stored inSprings. Torsion, Belleville and Rubber springs.	06 Hrs
	UNIT II	

03	Design of clutches: Torque transmitting capacity, multi disk clutches, friction materials, cone clutches, centrifugal clutches, energy equations and thermal consideration.	06 Hrs
	UNIT III	
04	Design of brakes: Energy equations, Block brakes, Double shoe or block brakes, Band brakes, Differential band brakes, Internal expanding brake. Thermal consideration.	06 Hrs
	UNIT IV	
05	Design of Gears: Introduction, classification of gears, terminology of spur gear, helical gear, bevel gear, and worm gear, selection of right kind of gear, force analysis in gears.	04 Hrs
06	Gear tooth failures, selection of material, beam strength of gear tooth(Lewis equation), effective load on gear tooth, estimation of module based on beam strength, dynamic tooth load, design for wear strength and endurance strength, estimation of module based on wear strength, internal gears, gear lubrication, procedural steps forthe design of spur, helical, bevel, and worm gears.	10 Hrs
	UNIT V	
07	Design of Sliding contact Bearings: Mechanisms of Lubrication – Viscosity, bearing modulus, coefficient of friction, minimum oil film thickness-Heat Generated, Heat dissipated, bearing materials, lubricants and properties. Examples of journal bearing and thrust bearing design.	07 Hrs
08	Design of Rolling contact Bearings: Advantages of rolling bearing compared to journal bearings, Classification of rolling contact bearings,Bearing life, equivalent bearing load, static and dynamic capacities of bearing, selection of bearing of different types.	03 Hrs

DESIGN DATA HAND BOOKS:

1. Design Data Hand Book – K. Lingaiah, McGrawHill,.
2. Design Data Hand Book – K. Mahadevan and Balaveera Reddy, CBSPublication
3. Machine Design Data Hand Book – H.G. Patil, ShriShashiPrakashan,Belgaum.
4. PSG Design Data Handbook PSG College of Technology, Coimbatore.

TEXTBOOKS:

5. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition2003.
6. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition2007.

REFERENCE BOOKS:

1. Machine Design: Robert L. Norton, Pearson EducationAsia,
2. Design of Machine Elements: M. F.Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, PearsonEducation.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special IndianEdition.

4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., NewDelhi,
5. Elements of Machine Design: N.C Pandey& C.S. Shah Chorotar Pub Anand (Gujarat)India.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	Quality Engineering– IP640
No. of Teaching Hours – 52	Credits : 4:0:0

Objective: To make an impression upon students in the learning of various Quality philosophies and quality tools to improve the organization's performance and customer satisfaction. The students learn about the basic concepts of quality assurance, statistical process control and control charts.

Course Outcome:

On successful completion of the course the students will be able to

1. Demonstrate the concept of Quality from producers and consumers prospective. Students are familiarized with fundamental basics & importance of quality control in organization.
2. Enlighten the different Quality philosophy and management strategies, importance of Reliability, Audit and other important basic responsibility of quality engineer.
3. Students identify the differences between attributes and variables data, basic principle of distribution curve and its importance. and causes of variations
4. Students will become familiar with control chart techniques of Variable data set & to find out its process capability for continuous quality improvement
5. Students will become familiar with control chart techniques of Attribute data set & to find out its process capability for continuous quality improvement

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Definition of Quality, Quality function, Dimensions of quality, Quality engineering terminology, Brief history of quality methodology, Customer needs and market share (KANO model) Definition and concept of quality assurance, departmental assurance activities. Quality circles and quality improvement teams, Product and service costing, Quality Costs - four categories costs and hidden costs. Quality and Productivity, Importance and benefits of quality control, case studies.	12 Hrs.
	UNIT II	
02	Quality philosophy and management strategies, Introduction to Quality Function Deployment. Quality audit concept, audit approach etc., structuring the audit program, planning and performing audit activities, audit reporting, and ingredients of a quality audit program. Inspection planning, responsibilities of quality manager. Reliability, ISO standards and applications.	10 Hrs
	UNIT III	
03	Basic statistical concepts: Introduction to concept of variation – Chance and Assignable causes of variation. Data collection, Probability distributions- Poisson and Normal distribution. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational sub groups. Statistical process control, Analysis of patterns of control charts. Case studies on application of SPC. Process capability - Basic definitions, standardized formula, relation to product tolerance and Six-Sigma concept of process capability.	11 Hrs
	UNIT IV	

04	**Control Charts for variables:** The Frequency distribution and Histogram. Control charts for X-bar and Range(R), statistical basis of the charts, development and use of X-bar and R charts, interpretation of charts. To calculate standard deviation, mean & Process capability.	09 Hrs
	UNIT V	
05	**Control Charts for Attributes:** Control chart for fraction non-conforming (defectives) - development and operation of control chart, brief discussion on variable sample size. Control chart for non-conformities (defects) - development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Guidelines for implementing control charts.	10

TEXT BOOKS:

1. -Introduction to Statistical Quality ControlII: D.C. Montgomery, John Wileyand Sons
2. Fundamentals of Quality Control & Improvement by Amitava Mitra(Auburn University, USA), Wiley publication 2008.
3. -Quality Planning and Analysis: J.M. Juranand FrankM. Gryna, TATA McGraw-Hill

REFERENCE BOOKS:

1. -Statistical Quality Control: Grantand Leavenworth, McGraw-Hill.
2. JanetL. Novack and Kathleen C. Bosheers, -TheQS9000 DocumentationToo lkitl Prentice Hall PTR
3. -ISO9000 A Manualfor total Quality Management: Suresh Dalelaand Saurabh,S. Chand anCd ompany Ltd, RamNagar, NewDelhi.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	LEAN & AGILE MANUFACTURING IP650
No. of Teaching Hours – 52	Credits : 4:0:0

Objectives:
The objective is to appreciate the students with the background, applications and current status of lean manufacturing and to make them understand the relevant basic principles in this field.

Course Outcome: On successful completion of the course the student will able to

1. Recognize the underlying philosophy of the Toyota ProductionSystem.
2. Analyze the different concepts of 5S, 3M, etc. to keep clean and standardizing theoperation.
3. Discover how to look at one's own shop floor in terms of lead-time reduction, waste elimination, JIT, VSM and materialflow.
4. Know the concepts and implementation of Jidoka and poka-yokesystems with agility
5. Develop and understanding of how to manage people in a Lean and agile environment in order to sustain improvements in productionmethod.

Chap No	Topics	Hrs
	UNIT I	
01	Introduction: The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda, concepts of TPM, One Point Lesson	10 Hrs.
	UNIT II	
02	Stability Of Lean System: Standards in the lean system – 5S system – Total Productive Maintenance – standardized work –Elements of standardized work – Charts to define standardized work – Man power reduction – Overall efficiency - standardized work and Kaizen – Common layouts. At least 2 Case studies on Kaizen	10 Hrs
	UNIT III	
03	JIDOKA (Automation with a Human Touch): Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka - At least 2 Case studies	6 Hrs
04	Worker involvement and Systematic Planning Methodology: Worker Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture - At least 2 Case studies	6 Hrs
	UNIT IV	
05	Competitive environment of the future- the business case for agile manufacturing conceptual framework for agile manufacturing.	10 Hrs

	Four Core Concepts: strategy driven approach- integrating organization, people technology interdisciplinary design methodology	
	UNIT V	
	Agile Manufacturing Enterprise Design: Agile manufacturing –enterprise design - system concepts as the basic manufacturing theory- joint technical & organizational design as a model for the design of agile manufacturing enterprise	6 Hrs
	Design & Skill of Knowledge enhancing Technologies for machine tool systems: Historical Overview, Lessons, Problems and Future Development.	6 Hrs

TEXT BOOKS:

1. Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, (Second edition), Productivity Press, New York,2007.
2. Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, Lean Enterprise Institute,1999.
3. -Agile Manufacturing-Forging New FrontiersII,PoulT Kidd,Amagow Co. UK,

REFERENCES:

1. Jeffrey Liker, The Toyota Way : Fourteen Management Principles from the World's Greatest Manufacturer,McGrawHill,
2. Michael L. George, Lean Six SIGMA: Combining Six SIGMA Quality with Lean Production Speed,McGrawHill,.
3. TaiichiOhno, Toyota Production System: Beyond Large-Scale Production, Taylor & Francis,Inc.,.
4. _AgileManufacturingII,AGunasekharan,the21stCenturyCompetitivestrategy,ISBN-139780- 08-04 3567-1, Elsevier Press,India
5. O Levine Transitions to Agile Manufacturing, Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsiw,USA
6. Agile Development for Mass Customization, David M Andeson and B Joseph Pine, Irwin Professional Publishing, ChicogoUSA

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
SEMESTER: VI

Subject Name & Code	COMPUTER AIDED MANUFACTURING LAB IP67L
No. of Teaching Hours –39 Hrs	Credits : 0:0:1.5 Maximum Marks: 50

Objective: The topic covers the aspects of CNC technology and the programming for the CNC lathe, milling jobs.
Course Outcome

1. Understand and apply the knowledge in writing the ISO programs for the turning and milling programme
2. Apply the simulation software in understanding the concepts of CNC lathe and Milling programs and learns the syntax and other intricate programming features.

Chap No	Topics	Hrs
01	Laboratory Classes 1. Writing and Execution of CNC programs using CNC lathe and Machining centre software a. CNC lathe programming – Simple programs on lathe- Canned Cycle Programming for lathe, subroutines,– Lab Exercises with related theory	12 Hrs
	b. CNC Milling programming – Simple programs on lathe- Canned Cycle Programming for Milling, controllers, subroutines – Lab Exercises with related theory	12 Hrs
02	2. Generation of ISO codes using CAM packages for Lathe and Milling Machines a. CNC lathe programming – Simple programs on lathe, Canned Cycle Programming for lathe controllers, subroutines,– Lab Exercises	09 Hrs
	b. CNC Milling programming – Simple programs on lathe, Canned Cycle Programming for Milling, subroutines – Lab Exercises	06 Hrs

TEXT BOOKS: 1. CNC programming Manuals

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	MECHATRONICS & ROBOTIC SYSTEMS IP661 ELECTIVE II
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective: The main objective of this course is to introduce the rapidly developing, multidisciplinary field of Mechatronic Engineering & Robotics which deals with the development of -smartIIelectromechanicalproducts, through an integrated design approach and a multidisciplinary point-of-view.

Course Outcome:

On successful completion of the course, the students will be able to:

1. Explain interdisciplinary insight to manufacturing system and at the end of the course, the students will be able to demonstrate the ability to function with multidisciplinary design team and can develop simple and cost effectivemethods.
2. Recalls the knowledge in the area of engineering technology, and they also apply the basic concept and engineering principle to analyze the performance of engineeringproblem.
3. Recalloninsighttooperationamplifier,protection,Dataacquisitionsystems,Digitalsignal processing.
4. Gain knowledge of Robotics and programming and modeling of robotsconfigurations.
5. Recognize Robotics sensors and visionapplications.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics, An over view of Mechatronics, Design of Mechatronics system, Measurements system and function of main elements of measurement systems, Need for Mechatronics in industries, Objectives, advantages and disadvantages of Mechatronics.Microprocessorbasedcontrollers,Principleofworkingofautomatic camera, engine management system and automatic washing machine.	05 Hrs.
02	Review of Transducers and Sensors**:** Definition and classification of transducers. (No detailed discussions on different type of transducers) Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors.	05 Hrs
	UNIT II	
03	Electrical Actuators: Actuator and actuator system, Classifications of actuator system with examples, Mechanical switches, Concept of bouncing Methods of Preventing bouncing of mechanical switches, Solenoids, Relays. Solid state switches – Diodes, Thyristors, Transistors, Darlington pair, Electrical actuator. Principle, constructionand working of AC, DC motors, stepper motors, permanent motors, servomotors,Servo	07 Hrs

	systems and control	
04	Signal Conditioning**:** Concept, necessity, op-amps, protection, filtering, wheat stone bridge – Digital Signals – Multiplexer. Data acquisition – Introduction to digital signal processing – Concepts and different methods	05 Hrs
	UNIT III	
05	Introduction to Robotics : Evolution of Robots and Robotics, Laws of Robotics, What is and What is not a Robot, Progressive Advancement in Robots, Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Programming Robots, The Future Prospects, Notations.	05 Hrs
06	Coordinate Frames, Mapping and Transforms : Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices	05 Hrs
	UNIT IV	
07	Symbolic Modeling of Robots – Direct Kinematic Model: Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transormation Matrix. Introduction to Inverse Kinematic model	08 Hrs
	UNIT V	
08	Robotic Sensors and Vision The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Robotic vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Description of Other components of Vision System, Image Representation, Image Processing.	07
09	Robot Applications: Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-Industrial Applications, Robotic application for sustainable Development	05 Hrs

TEXT BOOKS:

1. Mechatronics, W.Bolton, Longman, PearsonPublications,
2. Mechatronics by HMT Ltd. – TataMcGraw-Hill
3. Mechatronics – H.D. Ramachandra – SudhaPublication
4. Mechatronics – Principles, Concepts and applications – Nitaigour and Premchand, Mahilik – Tata McGrawHill
5. Mechatronics – W. Bolton, Pearson Education Asia.
6. CAD/CAM– Groover&Zimmers, PHI
7. CAD/CAM Principles & Applications – P.N.Rao, TataMcGraw-Hill
8. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMHPublications
9. Robotics for Engineers - Yoram Korean- McGrew HillCo.

REFERENCE BOOKS:

1. Introduction to mechatronics and measurement systems –David G. Alciatore& Michel BiHistand – Tata McGrawHill
2. Mechatronics System design by Devadas Shetty and Richard A. Kark – ThomasLearining.
3. Mechatronics an Introduction by Robert H Bishop –CRC
4. Mechatronics systems Fundamentals by Rolf Isermann –Springer
5. Industrial Robotics Technology programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey
6. Robotics Control Sensing, Vision and Intelligence - K.S.Fu, R.C.Gonzalex, C.S.G.Lee- McGrew hill Bookco.
7. Kinematics and Synthesis of Linkages - Hartenberg and Denavit - McGrew Hill BookCo
8. Kinematics and Linkage Design - A.S. Hall - PrenticeHall
9. Kinematics and Dynamics of Machinery - J.Hirchhorn - McGrew HillBookCompany

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JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	COMPOSITE MATERIALS IP 662 ELECTIVE II
No. of Teaching Hours – 52	Credits : 4:0:0

Course Objective: To impress the student about the study and analysis of composite materials, processing, and fabrication aspects. It also discusses some important care to be taken up in fabricating ceramic matrix composites.

Course Outcome:
On successful completion of the course the student will able to

1. Identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques with a specific case on fibre reinforcement plastic processing.
2. Understand the various fabrication of composites and analyze the case of ceramic matrix composites
3. Understand the applications and characterization ofcomposites.
4. Understand the industrial experimentation of composites with emphasis onMMC
5. Study and analyze advanced composites with respect to its properties andusage.

Chap. No.	Topics	Hrs
	UNIT I	
01	INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite materials – fibrous composites, laminatedcomposites, particulate composites. Properties and types of reinforcement and matrix materials.	06 Hrs.
02	FIBRE REINFORCEMENT PLASTIC PROCESSING: Layup and curing, fabricating process – open and closed mould process – hand layup techniques – structural laminate bag molding, production procedures for bag molding – filament winding, pultrusion, pulforming, thermo – forming, injection, injection molding, liquid molding, blow molding.	06 Hrs
	UNIT II	
03	FABRICATION OF COMPOSITES: Cutting, machining, drilling, mechanical fasteners and adhesive bonding, joining, tooling, fabricationequipment.	06 Hrs
04	CERAMIC MATRIX COMPOSITES: Their fabrication technologies.	06 Hrs
	UNIT III	
05	APPLICATION OF COMPOSITES: Characterization of composites usingScanning Electron Microscope (SEM), Introduction to shape memory alloys	08 Hrs

	UNIT IV	
06	APPLICATION OF INDUSTRIAL EXPERIMENTATION: Fabrication and testing of composites.	06 Hrs
07	STUDY PROPERTIES OF MMC'S: Physical Mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties.	06 Hrs
	UNIT V	
08	ADVANCED COMPOSITES: Such as Polymer based Sandwich structures of Nano composites. Introduction to shape memory alloys.	08 Hrs

TEXT BOOKS:

1. Composite Science and Engineering - K.K.Chawla Springer Verlag1998.
2. Introduction to composite materials - Hull and Clyne, Cambridge University Press, 2nd Edition, 1990.

REFERENCE BOOKS:

1. Composite Materials hand book - MeingSchwaitz,, McGraw Hill BookCompany,
2. Mechanics of Composite Materials - Robert. M. Jones, McGraw Hill KogakushaLtd.,
3. Forming Metal hand book - ASMhandbook,.
4. Mechanics of composites - Autar K kaw, CRCPress,
5. Composite Materials - S.C. Sharma Narora publishinghouse,
6. Principles of Composite Material mechanics - Ronald. F.Gibron

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	ENERGY ENGINEERING & MANAGEMENT IP 663 ELECTIVE II
No. of Teaching Hours – 52	Credits : 4:0:0

Objective: To impress upon the students relating to the various power plants and its use in the industries
Course Outcomes:
At the end of the course, the student should have clear understanding of

CO-1: To understand the basic principles involved in power generation, classification of power plants and to interpret, solve and plot various graphs and chart related to performance of the plant.

CO-2: To be able to understand the working of conventional power plant like - coal based thermal power plant by gaining the knowledge about the working of various sub-systems used in the power plant.

CO-3: To understand the working of generation of electricity from hydroelectric and nuclear power by studying essential components of the power plant. To be in a position to solve, and plot various graphs and charts related to Hydrographs. To be in a position to enumerate the advantages and disadvantages of choice of site chosen, system arrangements of the power plants with social, environmental and safety implications.

CO-4: To understand the fundamental principle involved in generating power from Solar and wind energy. To be in a position to know the working of various elements and sub-components in the power plant

CO-5: To understand and appreciate the possibilities of generating power using non-conventional energy sources like Tidal, OTEC, GTE and bio-mass energy. To be in a position enumerate the various socio-technical factors involved in generation of power from non-conventional energy sources.

Unit.	Topics	Hrs
Unit 01	Introduction to Power plants, classification of power plants, Selection criteria for suitable site for power stations, Selection of power plant equipment, Economics in plant selection Power plant Performance: performance and operating characteristics of power plants, types of loads, Different terms and definitions related to loads, load curves, load duration curves, numerical examples on load curve and load duration curve.	8 Hrs.
Unit 02	Steam Power Plant: General layout of steam power plants and essential components, Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, different types strokers, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling systems, A Brief Account Of Benson, Velox and Schmidt Steam Generators and its accessories such as Superheaters, De-superheater, Economizers, Air preheaters and re-heaters.	12 Hrs

Unit 03	Hydro-Electric Plants: General layout of hydel power plants with its essential components, Plant selection criteria, Classification of Hydroelectric power plants, discussion on comparison of hydroelectric power plant and thermal power plants, Classification and selection of hydraulic turbines, Calculation of available hydro-power, Specific speed of a turbine, Concept of Hydrographs, flow duration and mass curves (Numerical examples). Nuclear Power Plant: Brief overview of terminologies related to nuclear physics, principles of release of nuclear energy; Fusion and fission reactions, Chain reaction and concept of multiplication factor, Nuclear power systems with its essential components. Criteria for nuclear plant site selection, Elements of the nuclear reactor- moderator, control rod, fuel rods, and coolants. Selection of materials for reactor components, Brief description of principle and working of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Safety measures for nuclear power plants, Radiation hazards, Shielding, Radio- active waste disposal.	12 Hrs
Unit 04	Solar Energy: Solar energy – General terms and introduction, Solar radiation measuring instruments, Collectors in various ranges and applications – Flat plate collectors and Focusing type collectors, Solar pond technology, Low temperature thermal power generation using solar energy, Medium temperature systems using focusing collectors, High temperature systems. Wind Energy: Terms and definitions associated with wind energy, Properties of wind, availability and measurement of wind energy, wind velocity and power from wind, major problems associated with wind power, Types of wind machines - horizontal and vertical axis wind mills, Considerations for selection of site for wind energy conversion systems	12 Hrs
Unit 05	Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion: Principle of working, Open and Rankine cycle, problems associated with OTEC. Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy. Biomassenergy:Sourcesofbiogasenergyconversion,methodsofconversion,biogas productionparameters,Applications,factorsaffectinggenerationofbiogas,Applications.	08 Hrs.

TEXT BOOKS:

1. Power Plant Engineering, R. K. Rajput, Laxmi publication, NewDelhi.
2. Power Plant Engineering, Domakundawar, DhanpathRai sons.2003

REFERENCE BOOKS:

1.. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill.
2. Non-conventional Energy sources, G D RaiKhannaPublishers.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	AUTOMATIC CONTROL ENGINEERING – IP664 – ELECTIVE II
No. of Teaching Hours – 52	Credits : 4:0:0

Objective: To impress the student about the various aspects of controls and control systems to be considered in the field of automatic control.

Course Outcomes:
On Successful completion of the course, the student will able to:

1. Recall the basic concept of automatic control, represent the mathematical model of a system, convert it into transfer functions, Understand the controllers and to arrive at mathematical models for mechanical and electricsystems
2. Evaluate the response of first and second order systems for various step and ramp inputs. Analyze the stability of the system using mathematically concept ofstability.
3. Manage the block diagram representation and reduction, conversion of block diagram into signal flow graph, obtaining the transferfunction.
4. Understand the significance between magnitude and phase relationship between sinusoidal input and study state output and also to Predict the transfer function of the given system using Bode plots.
5. Visualize the effects of varying system parameter on rootlocation.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system.	05 Hrs.
02	Mathematical Model: Mechanical System (both translation and rotational), Electrical systems (servos, D.C. Motors, A.C. Servomotors),	07 Hrs
	UNIT II	
03	System Response: First order and second order system response to step and ramp inputs, concepts of time constant and its importance in speed of response. System of stability – Routh Hurwitz Criterion	10 Hrs
	UNIT III	
04	Block Diagrams, Signal Flow Graphs and Transfer Functions definition, function, block representation of system elements, reduction of block diagrams, Signal flow graphs, Basic properties and gain formula to block.	10 Hrs
	UNIT IV	
05	Controlaction: Types of controllers – Proportional, Integral, Proportional -Integral Differential controllers (PID) (Basic concepts only).	02 Hrs

06	System Analysis using Bode plots: Bode attenuation diagrams, Stability Analysis using Bode diagrams, Simplified Bode Diagrams.	08 Hrs
	UNIT V	
07	Root locus plots: Definition of root loci, constructing of root loci, Graphical relationship setting the system gain	10 Hrs

TEXT BOOKS:

1. Modern Control Engineering – K. Ogatta, Prentice Hall (India), Pearson Education.

REFERENCE BOOKS:

1. Feedback Control Systems – Schaum'sseries.
2. Control Systems by I.J. Nagarath& M. Gopal, New age InternationalPublishers.
3. Control Systems : M. Gopal, Tata McGraw Hill, NewDelhi.
4. Control System Engineering : S.N. SivanandomVikas Publishing House, NewDelhi.
5. Automatic Control Systems – B.C. Kuo Prentice Hall(India)

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
VII SEMESTER

Subject Name & Code	**HYDRAULICS & PNEUMATICS IP710**
No. of Teaching Hours – 39	**Credits : 3:0:0**

Course Objective

This course is essential in understanding the design, analysis, operation, maintenance and applications of fluid power systems.

Course Outcome:

On successful completion of the course the student will able to

1. Recall the basic concept of fluid mechanics, represent the structure of hydraulic system, able to identify different components of hydraulic system and to analyze the requirement of control components of hydraulic actuators and motors
2. Able to design and analyze the control components in hydraulic system for various situation with a suitable hydraulic circuit design
3. Plan the maintenance schedule for the hydraulic system and also to understand the Pneumatics systems
4. To analyze the directional control valves and its use in the hydraulic and pneumatic systems as per ISO 1219 and ISO5599.
5. Understand and analyze multi cylinder applications

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	**Introduction To Hydraulic Power:** Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps,vanepumps,pistonpumps,pumpperformance,pumpselection.Variable displacement pumps.	05 Hrs.
02	**Hydraulic Actuators and Motors:** Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.	04 Hrs
	UNIT II	
03	**Control Components in Hydraulic Systems:** Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.	04 Hrs

04	**Hydraulic Circuit Design and Analysis:** Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulate or circuits.	06 Hrs
	UNIT III	
05	**Maintenance of Hydraulic systems:** Hydraulic oils; Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.	04 Hrs
06	**Introduction to Pneumatic control:** Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application.	04 Hrs
	UNIT IV	
07	**Directional Control valves:** Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumaticcylinders,useofmemoryvalve.Flowcontrolvalvesandspeedcontrolof cylinders.	04 Hrs
	UNIT V	
08	**Multi-cylinder applications:** Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro-Pneumatic control: Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout.	08 Hrs

Text Books:

1. Fluid Power with applications: Anthony Esposito, Fifth edition pearson education,Inc.
2. Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co.

Reference Books:

1. Oil Hydraulic Systems: Principles and Maintenance, S.R. Majumdar, Tata McGraw Hill publishing company Ltd.
2. Pneumatic Systems: S.R. Majumdar, Tata McGraw Hill publishing Co.,

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	PLANT LAYOUT AND DESIGN IP720
No. of Teaching Hours – 39	Credits:3:0:0

Course Objective:
To understand and analyze the importance of layout models using appropriate design and computerized techniques

Course Outcomes:
On successful completion of the course the student will able to

1. Illustrate good understanding about the planning strategies, implementation evaluation and maintaining the facility and explain various theories of plant location, objectives of plant layout and plant design Immer, Nadler Muther, Apple James and Reed's approaches.
2. Understand the concepts of material handling and basic devices used in material handling with suitable examples.
3. Explain the Computerized layout planning like CRAFT, COFAD, PLANET, CORELAP, ALDEP and other aspects of plant design and its advantages and limitations
4. Demonstrate the Space determination procedure, Construction of the layout and Location Models.
5. Analyze the quantitative methods and models for the plant location and area allocation with the detailed construction of layouts

Chap. No.	Topics	Hrs
	UNIT I	
01	**Plant Location:** Factors influencing plant location, Theories of plant location and location economics, location problems	04 Hrs
02	**Objectives of plant layout:** Principles of plant layout, types of plant layout, Merits and Demerits of plant layout, Function of Plant layout, types of layout problems.	04 Hrs
	UNIT II	
03	**Material Handling:** Principles of material Handling, Objectives of Material handling, Unit load concept, classification of Material handling equipment's.	04 Hrs
04	**Basic devices used in Material Handling:** Basic devices & Types of Material handling equipment, unit load concept with examples.	04 Hrs
	UNIT III	
05	**Computerized layout planning:** CRAFT, COFAD,PLANET, CORELAP , ALDEP, concepts of the above systems and use of flow chart	04 Hrs
06	**Plant Design:** Systematic layout planning, activity relationship chart, relationship diagram, space relationship diagram to plant layout, approaches to layout procedures.	04 Hrs

	UNIT IV	
07	**Space Determination:** Space determination and area allocation, factors in space planning, receiving storage production shipping, tool room, tool crib and other auxiliary services, Factors to be considered for expansion, Flexibility aisles, columns etc.	08 Hrs
	UNIT V	
08	**Area Allocation-2 :**Allocation procedure for area, plot plan, sequence demand, straight line and directional methods and simple problems, line balancing. Assembly line balancing, fabrication line balancing, simple problem in line balancing, Ranked position weight method, JR Jackson's Method	04 Hrs
09	**Detailed construction of the layout:** Methods of constructing the layout, evaluation of the layout, efficiencies indices, presenting detailed layout to management	03 Hrs

TEXT BOOKS :

1. Plant layout and material handling- James apple.
2. Plant layout and design – James Moore.

REFERENCES :

1. Facilities planning and Design – Tompkins.
2. Plant layout materials handling – Richard Muther
3. Facilities design – Sunderesh Hergur.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	OPERATIONS MANAGEMENT IP730
No. of Teaching Hours: 39	Credits :3:0:0

Objective: By Studying Operations Management, students will be able to appreciate the:

- Role of operations management in strategic decision making.
- Firm's competitive advantages, key concepts and issues of OM in both manufacturing and service organizations.
- Interdependence of the operations functions with the other key functional areas of a firm, apply analytical skills and problem-solving tools to the analysis of the operations problems.

Course Outcome:

Upon successful completion of the course, students should be able to

1. Understand the fundamental concepts of operations management with emphasis on System Design, Capacity Planning and Decision making methodologies used in Manufacturing and Service organizations.
2. Understand and apply the knowledge forecasting, aggregate planning and master scheduling techniques for various cases.
3. Apply the knowledge of MRP, CRP and recognize the importance of controlling production activities in Organizations
4. Understand the various scheduling techniques and apply the same for typical cases encountered in Industrial environments.
5. Understand and apply the knowledge of OM concepts applied to different situations faced in service organizations.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction to Operations Management Concepts**:** Introduction, Historical development, The trend: Information and Non-manufacturing systems, Concept of productivity and its dimensions.	07 Hrs
02	System Design, Capacity Planning and Decision Making: Introduction, management as a science, characteristics of decisions, framework for decision making, decision methodology, decision support systems economics models, statistical models, Manufacturing and service systems, design and systems capacity and capacity planning	
	UNIT II	
03	Demand Forecasting: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, and Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of forecasts	08 Hrs.

	UNIT III	
05	Material and Capacity Requirements Planning: Overview: MRP and CRP, Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. Controlling Production Activities: PAC, objectives and data requirements, scheduling strategy and guidelines, scheduling methodology, priority control, capacity control.	08 Hrs.
	UNIT IV	
06	Scheduling: Concepts - , measures of performance, SPT rule, weighted SPT rule, EDD rule, minimizing the number of tardy jobs. Flow-Shop Scheduling: Introduction, Johnson 's rule for _n' jobs on 2 and 3machines, CDS heuristics.	08 Hrs.
07	Job- Shop Scheduling: Types of schedules, scheduling 2 jobs on _m' machines	
	UNIT V	
09	Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods	08 Hrs

Text Books:

1. Operations Management- Monks, J.G., McGraw-Hill International Editions,
2. Production and Operations Management- Pannerselvam. R, PHI.
3. Productions & operations management - Adam &bert. PHI

Reference Books:

1. Modern Production/Operations Management- Buffa, Wiely Eastern Ltd.,
2. Production and Operations Management- Chary, S.N, Tata-McGraw Hill.,
3. Operations management - James Dilworth. PHI,
4. Operations Management – Lee J Karjewski and Larry P Ritzman, strategy and Analysis, Pearson Education.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**INDUSTRY 4.0 IP741 ELECTIVE III**
No. of Teaching Hours – 39	**Credits : 3:0:0**

Course Outcome:

Upon successful completion of the course, students should be able to

1. Understand the fundamental concepts of Industry 4.0
2. Apply the knowledge & techniques of Industry 4.0 with emphasis on IoT.
3. Synthesis the knowledge and techniques to solve real life problems.

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	A Conceptual Framework for Industry 4.0, Introduction, Main Concepts and Components of Industry 4.0, State of Art, Proposed Framework for Industry 4.0, Lean Production Systems for Industry 4.0, Introduction, Literature Review, The Proposed Methodology, Automation Based Lean Production Applications.	08 Hrs
	UNIT II	
02	Lean Production Systems for Industry 4.0 , Automation Based Lean Production Applications, Maturity and Readiness Model for Industry 4.0 Strategy, Introduction, Existing Industry 4.0 Maturity and Readiness Models, Industry 4.0 Readiness, Industry 4.0 Maturity Model, Industry 4.0/Digital Operations Self-Assessment	08 Hrs
	UNIT III	
03	Technology Roadmap for Industry 4.0, Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, New Product and Process Development Phase , Talent Development for Industry 4.0, Skill Requirements in the Digital World Talent Development Practices for Industry 4.0	07 Hrs
	UNIT IV	
04	Data Analytics in Manufacturing, Introduction, Literature Review, Power Consumption in Manufacturing, Estimation of Manufacturing Cost , Smart Remote Machinery Maintenance Systems with Komatsu.	09 Hrs
	UNIT V	
05	Internet of Things and New Value Proposition, Introduction, Internet of Things (IoTs), Examples for IoTs Value Creation in Different Industries, IoTs Value Creation Barriers: Standards, Security.	07 Hrs

Text Books:

1. Industry 4.0: Managing the Digital Transformation, Alp Ustundag • Emre Cevikcan

NPTEL Resource Book

2. https://drive.google.com/file/d/17CPu--DdQHwUGzcbjDdNZbEcvHQ56-Cf/view

Reference Books:

3. Industry 4.0 by Navya Yugachi Olakh, 2019 edition
4. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, January 2019

Web Resources:

5. https://nptel.ac.in/courses/106/105/106105195/

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	**WORLD CLASS MANUFACTURING PRACTICES IP742 ELECTIVE III**
No. of Teaching Hours – 39	**Credits :3:0:0**

Course Objective:

Students understand the basics of WCMP and learn the economics behind technology implementation considering adopting and developing new products.

Course Outcome:

On successful completion of the course the student will able to

1. Understand the basic principle, practices, models of WCMP and how organizations gains competitive edge.
2. Understand the concepts of Business process re-engineering from WCMP perspective.
3. Appreciate the relevance of bench marking process & importance of people involvement in organizations to achieve world class standards
4. Understand the basic philosophy of TPM, importance of modern management tools to adopt in organizations to achieve world class status.
5. Appreciate the relevance of Six sigma and TRIZ philosophy in achieving World Class technology.

Chap. No.	**Topics**	**Hrs**
	UNIT I	
01	**Principals and Practices of WCM:** Introduction to WCM, Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management	04 Hrs
02	**Gaining Competitive Edge Through World Class Manufacturing:** Manufacturing Excellence and Competitiveness, What is world-Class Manufacturing-Hall's framework of world-Class Manufacturing (WCM), Gunn's Model of World-Class Manufacturing, Maskell's Model of World-Class Manufacturing, America's Best Plants Model of World Class Manufacturing.	04 Hrs
	UNIT II	
03	**Definition of Reengineering:** Definition of reengineering, Michael Porter's five factor model applicable to product and service organizations, Case studies on five factor model.	04 Hrs
04	**Importance of 3Cs**-customers takes charges, Characteristics of BPR, Role of information technology in reengineering process, barriers to reengineering, Deming prize and Baldridge award.	04 Hrs

	UNIT III	
05	**Benchmarking:** Definition, mission and objectives, managing benchmarking process, phases of benchmarking process, Documentation, performance measures, improving business processes.	08 Hrs
06	**Employee engagement:** Motivation, Employee surveys, Empowerment, Team dynamics. Decision making methodology, Suggestion system, Performance appraisal methods	
	UNIT IV	
07	**Total Productive Maintenance:** Introduction, Foundational Pillars of TPM, The Plan, Learning the New Philosophy, Promoting the Philosophy, Loss areas of TPM and OEE, Training, Improvement Needs, Goal, Developing Plans, Case examples.	08 Hrs
08	**Management Tools:** Why Why analysis, Force Field Analysis, Nominal Group technique, Affinity diagram, Interrelation diagraph, Process Decision Program Chart, Activity networkdiagram.	
	UNIT V	
09	**Theory of Inventive Problem Solving** (TRIZ), Overview of 40 principles and 39 parameters, applications of TRIZ and case examples on minimum ten principles.	07 Hrs
10	**Six Sigma:** The Basics, The core of Six Sigma (DMAIC), design for Six Sigma, DFSS and the customer, Quality time and the Bottom line , core of DFSS-IDOV method,	

TEXT BOOKS:

1. Reengineering the corporation -Hammer, Michael and James Champy.
2. A Manifesto for Business revolution, Nicholas Brealey Publishing ,London.-1993
3. Finding and implementing best practices -Champ ,Robert C. Business Process Benchmarking:, Vision Books- New Delhi –2008
4. World class manufacturing -Sahay B S ,Saxena K B C, Ashish Kumar, - A Strategic Perspective: MacMillan – India Ltd, ISBN0333-93-4741.
5. Six sigma for Managers -Greg Brue, TMH 2002, ISBN-0-07-048639-5

REFERENCE BOOKS:

1. Design for Six Sigma -Grege,,TMh
2. Design for Six Sigma in Technology and Product Development -Creveling, Pearson Education.
3. Total Quality Management -Dale H. Besterfield,carol Besterfield-Minchna,glen H Besterfield and Mary Besterfield –scare, Pearson education, ISBN81-297-0260-6
4. Total Quality Management - Kesavan R - I K International Publishing house Pvt.Ltd

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	Human Resource Management IP743 ELECTIVE III
No. of Teaching Hours – 39	Credits :3:0:0

Objective: The topic covers the need for planning, recruitment, training, appraisal and motivational aspects to be addressed to in order to effectively manage the organization. To know industrial laws to start and manage a company/industry

Course Outcome

Upon successful completion of this course, students should be able to :

1. Know the nature, Scope and objectives of HRM and the environmental factors that have effect on HRM and do effective HR planning, Job design and Job analysis
2. Describe the importance of both recruitment and selection process to select potential candidates for various jobs
3. Motivate group to achieve concern goal & objectives by acquiring the knowledge of motivation theories and study the performance appraisal methods
4. Understand the basic concepts of HR auditing and accounts and demonstrate with numerical examples.
5. Understand various industrial lawsandclearlyapplytheselawswithsuitableindustrialcaseexamples.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Introduction:** Overview, Objectives, competitive advantage, skills required. H.R. Policies, conceptual framework, methodologies	04 Hrs.
02	**Human Resource Planning:** Integrated strategic planning and human resources planning HRP at different levels, Process of HRP, Control and review mechanism.	04 Hrs
	UNIT II	
03	**Recruitment:** Need, Sources and techniques of recruitment assessment of recruitment programs Selection, Placement and Induction: Meaning, Significance factors affecting decisions, procedure, concept of testing, Interviews, Placement and induction process Training the work force: Importance, scope, training verses development, training process, techniques - Career Management - Planning and Development.	08 Hrs
	UNIT III	
04	**Leading:** Motivation – Human factors in managing, Motivation and Motivators, The hierarchy of needs theory, Theory X and Theory Y, The Motivation-Hygiene theory, Immaturity-Maturity theory, A systems and contingency approach to Motivation, Situational, or Contingency, approach to leadership	04 Hrs
05	**Performance Appraisal:** Meaning, need, purpose, content, legalities of performance appraisal. Methods of performance appraisal – traditional, graphic rating scales, ranking, paired comparison, forced distribution, checklist, critical incidence, essay or free form, Groupconfidentialreports.BehaviourallyAnchoredRatingScales(BARS)andrelated	04 Hrs

	Modern Scales	
	UNIT IV	
06	**HR audit, HR accounting,** absenteeism, labour turnover, separations, promotion, transfer, research in HRM, HR records, importance of HRIS, management of knowledge workers - HRM in future, International HRM.	04 Hrs
07	**Compensations Management:** Concept and Theories of wage machinery, Benchmarking– Performance linked compensation system – statutory requirement in compensation Management.	04 Hrs
	UNIT V	
09	**Industrial Safety and Welfare:** 1. The Factories Act 1948: Health, safety and welfare - hours of work - holidays and leave with pay - employment of women and children inspection and regulation. 2. The Employees Provident Fund Act1952. 3. The Industrial Disputes Act1947. 4. The Industrial Employment (Standing Orders) Act1946 5. The Payment of Wages Act1936 6. The Minimum Wages Act1948 7. The Payment of Bonus Act1965 8. The Equal Remuneration Act1976.	07 Hrs

TEXT BOOKS :

1. P.SubbaRao,-HumanResourceManagementandIndustrialRelationsII,Text,CasesandGames,New Delhi:Himalaya Publishing House
2. Human resource and personnel management by K.Aswathappa.
3. C.B. Memoria, -Personnel ManagementII Himalaya Publishing

REFERENCE BOOKS:

1. Dessler, Gary, Human Resources Management, New Delhi: Prentice Hall of IndiaPvt.Ltd.
2. Saiyadain, Mirza S., Human Resource Management, New Delhi:TMH,.
3. San Beardwell and Len Holden, Human Resource Management, New Delhi:Macmillan,
4. Nair,N.G. and Latha Nair, Personnel Management and Industrial Relations, New Delhi: S.Chand& Co.
5. Peter C.Cairo,-Counselling in Industry–Personnel PsychologyII
6. Wayne F Cascio, -Management Human ResourcesIITATAMcGraw HillNew Delhi.
7. H.John Bernardino, and Joyce E.A Russel, -Human Resource ManagementII, McGraw HInternational Editions.

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Subject Name & Code	**MECHANICAL VIBRATIONS IP744 Elective III**
Total Contact Hours: 39	**Credits (L:T:P): 3:0:0**

Course Outcome:

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

CO1: Understand and explain free vibration, forced vibration, single degree, two degrees and multi degrees of freedom systems, vibration measuring instruments, and continuous systems.

CO2: Apply knowledge to determine the frequency response of free and forced vibrations systems.

CO3: Analyse and derive the vibration characteristics of free and forced vibration systems, single and two degrees of freedom systems in terms of natural frequency, mode shapes and coupling phenomena.

CO4: Demonstrate the characteristics of continuous vibrating systems and multi degrees of freedom systems.

Chap. No.	Topics	Hrs
	UNIT I	
01	Introduction: Types of vibrations, S.H.M, Principle of super position applied to simple Harmonic Motions, Beats. Fourier theorem and simple problems. Single degree of freedom systems and simple problems.	04 Hrs.
02	Un damped Free Vibrations: Introduction, un damped free vibrations –natural frequency of free vibrations, stiffness of spring elements, and effect of mass of spring.	04 Hrs
	UNIT II	
03	Damped Free Vibrations: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping , critical and over damping, Logarithmic decrement.	06 Hrs
	UNIT III	
04	Forced Vibration: Single degree freedom systems, steady state solution with viscous damping due to harmonic force, solution by complex algebra, concept of response, Reciprocating and rotating unbalance, vibration isolation- Transmissibility ratio. Energy dissipated by damping, sharpness of resonance, base excitation.	04 Hrs
05	Vibration Measuring Instruments: Accelerometer and vibrometers, Whirling of shafts with and without air damping. Discussion of speeds above and below critical speeds.	06 Hrs
	UNIT IV	
06	Systems with Two Degree of Freedom: Introduction, principle modes and normal modes of vibrations, Co-ordinate coupling, generalized and principle co-ordinates, free vibrations in terms of initial conditions. Geared systems. Forced Oscillations – Harmonic excitation. Applications: a) Vehicle suspension (b) Dynamic vibration absorber(c) Dynamics of Reciprocating Engines.	07 Hrs

	UNIT V	
07	Continuous Systems : Introduction, vibration of string, longitudinal vibration of rods, torsional vibrations of rods Euler's equation for beams, simple problems M.D of systems. Introduction, influence co-efficient, Maxwell Reciprocal theorem.	04 Hrs
08	Numerical Methods for Multi Degree Freedom Systems: Dunkerly's equation. Orthogonality of principle modes,.Hozler's method, geared and branched systems, Rayleigh's method, Stodola method.	04 Hrs

TEXT BOOKS :

1. Fundamental Mechanical Vibration – S .GrahamKelly, Tata McGraw Hill,2000.
2. Mechanical Vibrations – Singireru .Mcgrawhil, Pearson Education Inc. 4thEdition, 2003.

REFERENCEBOOKS:

1. Mechanical Vibrations- Kelly Schum's outline series . McGrawHill.
2. Vibrations- TSE, Morse &Hindle prentice HallIndia
3. Mechanical Vibrations –Austins H.Church, John Wiley andsons,Theory & Practice of Mechanical Vibrations:J.S. Rao & k. Guptha , New Age Intl.,Publication.
4. Theory of Vibration with applications – William T. Thomson and maric Dillon Dahleh, pearson Education Inc.
5. Vibrations- Balakumar Balachandran and Edward B. Magrab, ThomsonAsia,
6. Fundamentals of Mechanical Vibrations- S .GrahamKelly, Tata McGraw Hill, International Edition

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	ENGINEERING ECONOMICS IP751 ELECTIVE IV
No. of Teaching Hours – 39	Credits :3:0:0

Objective: To impress upon the students relating to the taxation, cash flow analysis, Methods of Depreciation and its effects.

- Provides clear understanding of the fundamentals of engineering economics.
- Learn the concepts of decision making, problem solving, and comparison of the alternatives and elements of cost.

Course Outcome:
On successful completion of the course the student will able to

1. CO1: Define and explain the basic concepts of Engineering Economics, importance of decision making, supply and demand concepts, types of interest, interest factors, characteristics of taxation, replacement principles, and methods of depreciation and components of cost accounting.
2. CO2: Apply the knowledge to calculate interest rate, present and future worth comparisons, equivalent annual worth comparisons of business projects, rate of depreciation, EMI's, rate of return in starting new ventures.
3. CO3: Analyze cash flow diagram, different methods of comparison, like present worth, equivalent worth comparisons, perform replacement analysis, break even analysis, minimum cost analysis
4. CO4: Demonstrate the principles of an ideal taxation system in managing projects in multi-disciplinary environment.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Introduction:** Engineering Decision-Makers, Engineering and Economics, Demand & Supply. Agents of production, labour & its characteristics	02 Hrs.
02	**Interest and Interest factors**: Interest rate, Simple interest, Compound interest, interest formulae, Cash – flow diagrams, Exercises and Discussion.	06 Hrs
	UNIT II	
03	**Present Worth Comparisons:** Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay-back comparison, Exercises, Discussions and problems.	04 Hrs
04	**Taxation:** Direct & Indirect cost, Characteristics of a good taxation system	04 Hrs

	UNIT III	
05	**Equivalent Annual Worth Comparisons:** Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems	08 Hrs
06	**Replacement Analysis:** Basic reason for replacement, installation & removal costs, common errors in replacement studies	
	UNIT IV	
07	**Depreciation and Tax:** Nature of Depreciation, Causes of Depreciation, Basic methods of depreciation - Straight line, declining balance, sum of the years digit method and sinking fund method. Problems	08 Hrs
	UNIT V	
08	**Cost & Cost Accounting:** First cost, fixed cost, variable cost, incremental cost, sunk cost and marginal cost. Break even analysis and minimum cost analysis. Direct Material Costs, Direct Labour indirect manufacturing expenses, allocation of factory overheads.	07 Hrs

TEXT BOOKS:

1. RIGGS J.L., Engineering economy, McGrawHill
2. THUESEN H.G., Engineering economy,PHI

REFERENCE BOOKS:

1. TARACHAND, Engineering economy
2. OP KHANNA, Industrial Engineering and Management, Dhanpat Rai &Sons.
3. I M PANDAY , Financial Management , Vikas Publishing House
4. PAUL DEOARMO, Engineering economy, Macmillan Pub,Co

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Subject Name & Code	TECHNOLOGY MANAGEMENT IP752 ELECTIVE IV
No. of Teaching Hours – 39	Credits :3:0:0

Course Outcome:

Upon successful completion of the course, students should be able to

1. Understand the fundamental concepts of Technology management with emphasis on Technology Acquisition, Technology Strategy and Competitiveness and Adaption
2. Apply the knowledge & techniques for various cases.
3. Synthesis the knowledge and techniques to solve real life problems

Chap No.	Topics	Hrs
	UNIT I	
01	**Introduction to Technology Management:** Concept and Meaning of Technology and Technology Management- Technology; Technology management, Evolution and Growth of Technology, Role and Significance of Technology Management, Impact of Technology on Society and Business- Technology and competition; Key issues in managing technological innovation, Forms of Technology- Process technology; Product technology	08 Hrs
02	**Technology Acquisition:** Technology Acquisition, Alternatives for Acquiring New Technologies, Reasons Compelling a Company for Obtaining a New Technology, Management of Acquired Technology, Measures of Scale and Mechanisms for Acquiring Technologies- Economy of scale or Scale economy; Levels of scale; The measurement of scale; Factors affecting the choice of scale	
	UNIT II	
03	**Technology Strategy and Competitiveness:** Technology Strategy-Technology strategy and management; Elements of an accessible technology strategy, Innovation Management, Competitive Advantage- Components of competitive advantage; Creating competitive advantage using value chain, Technology Management Evaluation or Assessment	08 Hrs.
04	**Technology Adoption, Diffusion, and Absorption:** Technology Adoption, Technology Diffusion- of technology diffusion; Perspectives of innovation diffusion process; Activities necessary for diffusion process, Technology Absorption- Role of technology absorption; Benefits of technology absorption; Constraints in technology absorption, Technology Package and Technological Dependence, Indian Experience in Technology Absorption Efforts, Issues Involved in the Management of Technology Absorption and Government Initiatives	
	UNIT III	
05	**Aspects and Issues in Technology Management:** Technological Change- Characteristics of technological change; Classification of technological change; Impact of technological change, Technology Life Cycle, Technology Transformation, Technology	08 Hrs.

	Policies and Policy Instruments, Technological Development Options and Strategies, Technology and Socio-Economic Planning, Diffusion and Growth of Technologies- Information technology revolution; Macro effects of technological change	
06	**Technology Transfer:** Transfer of Technology, Models of Technology Transfer- Traditional technology transfer models; Qualitative technology transfer models, Technology Transfer Modes, Dimensions of Technology Transfer, Features of Technology Package, Routes of Technology Transfer	
	UNIT IV	
07 08	**Managing Technology Based Innovation:** Innovation and Technology- Innovation – Technology relationship; Technological innovation and management, Process of Technology - Based Innovation, Measures of Innovative Performance, Characteristics of Innovative Work Environment, Key Areas of Management Focus for Productive Innovation, Measures for Building High-Performing Innovative Technology- Based Organization's.	08 Hrs.
	Knowledge Based Technologies and Knowledge Management: Knowledge Based Technology and Techniques - Knowledge based technology process; Tools and techniques, Role of Artificial Intelligence Techniques, Knowledge Management Techniques for Technology Management	
	UNIT V	
09 10	**Human Aspects in Technology Management:** Integration of People and Technology, Factors Considered in Technology Management- Organizational factors; Psychological factors, Organizational Structure and Technology	07 Hrs.
	Social Issues in Technology Management: Social Issues, Technological Change and Industrial Relations- Implementation of rationalization and automation in India; Impact of technological change, Technology Assessment and Environmental Impact Analysis- Environmental impact analysis process- Guidelines on the scope of EIA; Issues in preparation of EIA report; Elements of the environmental problem	

Text Books:

1. Management of New Technologies For Global Competitiveness — Christian N Madu - Jaico Publishing,
2. Technology management by IGNOU

Reference Books:

1. Strategic Technology Management - Betz. F. - McGraw-Hill.
2. Management of Technology - Tarek Khalli -, McGraw-Hill.
3. Strategic Management of Technological Innovation - Schilling - McGraw-Hill, 2nd ed.
4. Managing Technology and Innovation for Competitive Advantage - V K Narayanan - Pearson Education Asia
5. Strategic Management of Technology & Innovation - Burgelman, R.A., M.A. Madique, and S.C. Wheelwright -. Irwin.
6. Handbook Of Technology Management - Gaynor - Mcgraw Hill
7. Managing New Technology Development - Souder, W.C. and C.M. Crawford – McGraw-Hill.
8. Managing Technological Innovation - Twiss, B. -. Pitman.
9. Bringing New technology To Market - Kathleen R Allen - Prentice Hall India

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Subject Name & Code	**ORGANIZATIONAL BEHAVIOUR IP753 ELECTIVE III**
Total No. of Hours – 39	**Credits :3:0:0**

Course Objective:

- Students will learn the concepts of OB based on different models
- Understand the foundations of individual and group behavior which affect the organizational performance and effectiveness.

Course Outcomes:

1. To familiarize foundations of Organizational Behaviour by understanding the individual Psychological Abilities and personality of the organizational stake holders.
2. To understand the perceptual theory, learning theories and skill acquisition of an individual from organizational behavior perspective.
3. To understand the importance of different values and attitudes of an individual. To recognize the importance of organizational communication theory and organizational conflict process.
4. To be able to comprehend the basic motivational theories and leadership styles pertaining to individual level and to organizational settings.
5. To be able to understand group dynamics in organizational settings, also to understand job satisfaction and stress management with reference to organizational settings.

Chap No	**Topics**	**Hrs**
	UNIT I	
01	**Introduction:** Definition of Organisation Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems). The Individual: Foundation of individual behaviour, Personality theory and Individual ability	08 Hrs.
	UNIT II	
02	**Learning:** Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social making, learning theory, Dreyfus Skill acquisition principles, continuous and intermittent reinforcement. **Perception:** Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect	08 Hrs
	UNIT III	
03	**Values and Attitudes:** Definition – values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance, Values and attitudes- terminal values and instrumental values, formation of attitudes, sources of attitudes and measurement of attitudes. Organizational communication types, mediums and barriers to communication, Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process.	08 Hrs

	UNIT IV	
04	**Motivation:**Maslow's Hierarchy of Needs, Mc. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor Vroom's expectancy theory of motivation. **Leadership:** Definition, Behavioural theories – Blake and Mounton managerial grid, **Contingency theories** – Hersey - Blanchard's situational theory, Leadership styles – characteristics, Transactional, transformation leaders	08 Hrs
	UNIT V	
05	**The Group: Definition and classification of groups,** Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making. Workplace stress management and job satisfaction-its relationship to productivity,absenteeism and employee turnover.	07 Hrs

TEXT BOOKS:

1. Organizational Behaviour - Stephen P Robbins –Pearson Education Publications
2. Organizational Behaviour – Schermerhorn - Wiley India PvtLtd.
3. Management of Organizational Behavious - Paul Henry and Kenneth H. Blanchard - Prentice Hall ofIndia.
4. Organizational Behaviour – Fred Luthans - McGraw Hill International Edition

REFERENCE BOOKS:

1. Organisational Behaviour – Hellriegel, Srocum and woodman, Thompson Learning - Prentice Hall India-.
2. Organizational Behaviour – VSP Rao and others – KonarkPublishers

Subject Name & Code	**TOOL ENGINEERING DESIGN & FIXTURES IP754 ELECTIVE IV**
No. of Teaching Hours – 39	**Credits :3:0:0**

Course Objectives: To establish the design of cutting tools and appropriate jigs & fixture from the industrial perspective.

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Course Outcome

Upon successful completion of this course, students should be able to :

1. Understand the design of single point cutting tools and critically analyze for CNC cutting tools and drill bits, reamers with suitable exercises.
2. Understand the design of form tools and critically analyze for different types of form tools and design the milling cutters with suitable exercises.
3. Understand the design of broaches and critically analyze for different types of broaches and understand basic concepts of jigs, fixtures and the principles of locations
4. Design and analyze the various types of jigs and their indexing methods for various machine tools
5. Design and analyze the various types of clamping devices and other types of clamping methods for various machine tools

Chap. No.	Topics	Hrs
	UNIT I	
01	**Cutting Tools:** Development of cutting tool materials. Design of single point tools for turning,. Problems	04 Hrs.
02	**Design of Drills :** Taper shank, Straight Shank, Design of reamers, Strength and rigidity calculations, Exercises,	04 Hrs
	UNIT II	
03	**Design of Form Tools:** Calculations of tool profile for flat tools, circular form tools, Exercises on Form tools,	04 Hrs
04	**Design of Milling Cutters:** Types, calculation, sharpening, design details – Tools for threads – Design of threading taps for metric threads. Exercises	04 Hrs
	UNIT III	
05	**Design of Broaches:** –Exercises on Broaches for the given job, Strength and rigidity calculations	04 Hrs
06	**Jigs & Fixtures:** Tolerance analysis and procedure of designing. The economic calculations, location of the work piece, degree of freedom, references surfaces, resting components, fixture elements for surface concentric and radial locations	04 Hrs
	UNIT IV	
07	**Indexing Methods** – Basic indexing and design of Jigs and Accessories, types of drill jigs , jig bushes, and its applications for Drilling. Indexing of jobs for Milling, Turning machines.	07 Hrs
	UNIT V	
08	**Clamping of the work piece:** Principles, types and methods of clamping. Quick clamping devices, standards.	08 Hrs

TEXT BOOKS:

1. Tool Design - C Donaldson- G.H. Le CAIN V.C Goold, TMH
2. Metal cutting theory and Tool Design- Arshinav MIR Publications

3. Introduction to Jigs & Fixtures- Kempster. ELBS
4. Fundamentals of Tools Design- ASTME – Prentice Hall India Publications

REFERENCEBOOKS:

1. Metal Cutting and Tool design - Dr. B.J. Ranganath, Vikas Publishing house

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VIII SEMESTER

Subject Name & Code	COMPUTER INTEGRATED MANUFACTURING IP810
No. of Teaching Hours – 39	Credits :3:0:0

Course Objective:

To make student learn the techniques of automation, planning, material handling, computer networks and inspection methods used in manufacturing systems

Course Outcome

Upon successful completion of this course, students should be able to :

4. Describe automation in production systems, manufacturing systems and production concepts
5. Understand the objectives of automated flow lines and its balancing with the methods.
6. Understand the concept of CAPP ,MRP and should critically evaluate its concepts.
7. Study and analyse the phases of shop floor control in an industrial environment and also know the concepts of Computer networks in manufacturing
8. Study and collect through cases the future trends in manufacturing and also critically analyze the role of humans in future automated factory.

Chap. No.	Topics	Hrs
	UNIT I	
01	**Automation:** Definition, Types, Reasons for Automating, Arguments for and against Automation.	04 Hrs
02	**Production Concepts and Mathematical Models:** Automation Strategies. Problems	04 Hrs
	UNIT II	
03	**Automated flow Lines:** Objectives of the use of flow line automation. Transfer Mechanisms – Linear & Rotary	04 Hrs
04	**Methods of Line Balancing:** Largest Candidate rule, Kilbridge and Wester's method with illustrations	04 Hrs
	UNIT III	
05	**Computer Aided Process planning :**Retrieval Type and Generative Type and its applications	04 Hrs
06	**Material Requirement Planning:** Fundamental's concept of MRP- Inputs to MRP, applications	04 Hrs
	UNIT IV	
07	**Shop Floor Control:** The 3 Phases of shop floor control, Factory Data collection systems, applications, INTERNET OF THINGS	04 Hrs

08	**Computer Networks for Manufacturing:** Hierarchy of Computers in Manufacturing. Benefits of the Hierarchical Systems	04 Hrs
	UNIT V	
09	**Future Trends in Manufacturing :** Future Automated Factory, Case studies	04 Hrs
10	**Human Workers in the future automated Factory:** Social Impact, other important considerations	03 Hrs

Text Books:

- Automation production Systems & CIM-M.P.Groover.
- CAD/CAM –M.P.Groover

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Subject Name & Code	JUST IN TIME MANUFACTURING IP821 ELECTIVE V
No. of Teaching Hours – 39	Credits :3:0:0

Course Objective:
To learn the basic concept of Just in Time Manufacturing and methods to be adopted for implementing JIT practices.

Course Outcome:
On successful completion of the course the student will able to

1. Recognize the underlying philosophy of the Toyota Production System.
2. Know the concepts and implementation of Kanban, Jidoka and Value Stream systems.
3. Analyze the different concepts of Kanban and Pokayoke. to keep material control and avoid mistake proofing in the operation.
4. Discover how to look at one's own shop floor in terms of lead-time reduction, waste elimination and material flow.
5. Implementing the continuous improvement concept and Taylor's principles and Develop and understanding of how to manage people in a JIT environment in order to sustain improvements in production method.

Chap No	Topics	Hrs
	UNIT I	
01	**JIT-An Introduction:** Spread of JIT movement, the new production system research association of Japan, some definitions of JIT, core Japanese practices of JIT, creating continuous manufacture, enabling JIT to occur, basic element of JIT, benefits of JIT.	03 Hrs.
02	**Toyota Production System:** Key features and basic framework, Production smoothing, production planning, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production, Shortening lead time and reducing the setup time in Toyota production system	05 Hrs
	UNIT II	
03	**Kanban system** – Basics of Kanban system, Kanban rules, adapting to fluctuations in demand through Kanban, Types of Kanbans cards- Withdrawal, Production ordering, subcontract, emergency Kanbans, concept of whirligig, Andon, determining the number Of Kanbans, detailed Kanban systems with examples.	04 Hrs
04	**Value Stream Mapping** – The concept, the symbols, current state value stream mapping and future state value stream mapping, Value Network Mapping, a case study to implement VSM, pokayoke mistake proofing.	04 Hrs
	UNIT III	
05	**Design, Development and Management of JIT Manufacturing Systems:** Plant configurations and flow analysis, comparison of JIT's -demand pull system with	08 Hrs

	conventional-push type II planning and control systems, quality management system product design, human resource management, flexible workforce system, creation and maintenance of teams for the implementation of JIT in an industry. Assessing performance in JIT manufacturing systems, product costing information systems in JIT manufacturing, Case studies	
	UNIT IV	
06	**Supply Management For JIT:** JIT purchasing-the Japanese way, some studies in JIT purchasing, experience of implementation organizations, surveys on JIT purchasing, buyer-seller relationship in JIT purchasing, quality certification of suppliers in JIT purchasing, some problems in implementation of JIT purchasing, reduction freight costs in JIT purchasing, monitoring supplier performance for JIT purchasing, audit in JIT purchasing, implementation of JIT to international sourcing, frequency of shipments, inventory policy, supplier reaction capability, quality, communication sole sourcing, delivery performance and supplier flexibility, conclusion.	08 Hrs
	UNIT V	
08	**Framework for Implementation of JIT:** Implementation risks - Due to inappropriate understanding, technical, operational and people problems, in Kanban system, Value stream Mapping. Activities to be performed during the implementation, steps in implementation, a case study to implement JIT.	07 Hrs

TEXTBOOKS:

1. M.G. Korgaonker: -Just In Time Manufacturing II, Macmillan India Ltd.
2. Richard J. Schonberger:-Japanese Manufacturing Techniques II The Free Press–Macmillan Pub. Co, Inc. New York

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Subject Name & Code	Additive Manufacturing IP822 ELECTIVE V
No. of Teaching Hours – 39	Credits :3:0:0

Objective: To introduce students:

1. Basics of additive manufacturing/rapid prototyping and Its applications in various fields, reverse engineering techniques
2. To understand and appreciate the difference between subtractive manufacturing and additive manufacturing
3. To learn the concept of joining of materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodology.
4. To understand the cutting edge technology of Rapid Prototyping its potential to extensively transform the nature of manufacturing processes.
5. About mechanical properties and geometric issues relating to specific rapid prototyping applications.

Course Outcomes:

1. Understand the importance of prototyping concepts with emphasis on Rapid manufacturing processes. Understand role of additive manufacturing in product development.
2. Recognize the techniques of Liquid, Solid and Multi Jet based Additive Manufacturing Systems and its applications in various domains.
3. Understand the various techniques involved in Powder based AM and Rapid tooling techniques
4. Recognize the role of Reverse engineering in Additive Manufacturing and understand the importance of various data digital representation formats
5. Understand and appreciate the uses of Additive manufacturing in range of domains from engineering and other fields.

Chap. No.	Topics	Hrs
	UNIT I	
01	**INTRODUCTION:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), and classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.	08 Hrs.
02	**OVERVIEW OF ADDITIVE MANUFACTURING**– History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications	
	UNIT II	
03	**LIQUID BASED ADDITIVE MANUFACTURING SYSTEMS** Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing	08 Hrs
04	**SOLID-BASED AM SYSTEMS:** Laminated Object Manufacturing (LOM): Models and	

	specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. **MULTI-JET MODELLING (MJM):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
	UNIT III	
05	**POWDER BASED ADDITIVE MANUFACTURING and 3D Printing SYSTEMS:** Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.	08 Hrs
06	**RAPID TOOLING: INTRODUCTION TO RAPID TOOLING (RT), CONVENTIONAL TOOLING VS RT, NEED FOR RT. RAPID TOOLING CLASSIFICATION:** Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Kel tool process. Direct Rapid Tooling: Direct AIM,LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using3DP	
	UNIT IV	
07	**AM & REVERSE ENGINEERING:** Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology, concept of Reverse Engineering, nature and characteristics.	08 Hrs
08	**AM DATA FORMATS: REENGINEERING FOR DIGITAL REPRESENTATION**, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques. AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, SolidView, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.	
	UNIT V	
09	**AM APPLICATIONS: APPLICATION** – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts andArchitecture.	07 Hrs
10	**RP MEDICAL AND BIOENGINEERING APPLICATIONS:** Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Bio-molecules. Web Based Rapid Prototyping Systems.	

TEXT BOOKS:

1. Chua C.K., Leong K.F.,andLimC.S., -Rapid prototyping: Principlesand applicationsll, ThirdEdition, World ScientificPublishers,.
2. GebhardtA.,-Rapid prototypingll, Hanser Gardener Publications.

REFERENCES:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, Springer, Brent Stucker, David W. Rosen, and IanGibson,
2. Liou L.W. and Liou F.W.,-Rapid Proto typing and Engineering applications:A tool box for prototype developmentll, CRC Press
3. KamraniA.K. and Nasr E.A., -Rapid Prototyping:Theory and practicell, Springer, 2006.

JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	SUPPLY CHAIN MANAGEMENT IP823 ELECTIVE V
No. of Teaching Hours – 39	Credits :3:0:0

Course Objective:

To conceptualize, design and implement supply chains aligned with product, market and customer characteristics. Managing the flow of products , information , and revenue across supply chains differentiates the ability of supply networks to fulfill customer needs.

Course Outcomes

On successful completion of the course the students will be able to

1. Develop the ability to explain basic supply chain strategies and practices and to define the role, factors and framework for supply chain design decisions.
2. Explain the models for facility location and capacity allocation and selection decision using analytical way.
3. Demonstrate the Optimum level of product availability through managing and planning of inventories, concept to improve supply chain profitability
4. Explain the role, assessment and selection of the supplier and transportation and pricing concept in supply chain
5. Define the importance and coordination between the stages of supply chain, Bull whip effect.

Chap. No.	Topics	Hrs
	UNIT I	
01	Building a Strategic Frame Work to analyse Supply Chains**:** Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit. Case discussions.	04 Hrs.
02	Designing the Supply Chain Network**:** Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions.	04 Hrs.
	UNIT II	
03	Facility Location and Network Design**:** Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision using decision trees. Analytical problems.	08 Hrs
	UNIT III	
04	Planning and Managing Inventories in a Supply Chain: Review of inventory concepts. Trade promotions, Managing multi-echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on Safety inventory. Optimum level of product availability; importance factors.Managerial	08 Hrs

	levers to improve supply chain profitability.	
	UNIT IV	
06	Sourcing, Transportation and Pricing Products**:** Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration**:** Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation. Analytical problems. Role Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts.	08 Hrs
	UNIT V	
07	Coordination and technology in the Supply Chain**:** Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships.	04 Hrs
08	Coordination and technology in the Supply Chain**:** The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice. Case discussion. Lean supply chains, Implementation of Six Sigma in Supply Chains.	03 Hrs

TEXT BOOK:

1. Supply Chain Management – 2001, Strategy, Planning & Operation. Sunil Chopra & Peter Meindl; Pearson Education Asia, ISBN:81-7808-272-1.

REFERENCE BOOKS:

1. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems, Robert B Handfield, Ernest L Nichols, Jr. 2002, Pearson Education Inc, ISBN:81-297-0113-8
2. Modelling the Supply Chain- Jeremy F Shapiro, Duxbury 2002, Thomson Learning, ISBN 0-534-37363

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	Industrial Robotics IP824 ELECTIVE V
No. of Teaching Hours – 39	Credits :3:0:0

COURSE OBJECTIVES:

1. To understand the basics of automation and brief history of robot and applications.
2. To understand the kinematics and dynamics of robots.
3. To understand about robot drive system and control systems.
4. To understand about Robot Programming methods & Languages of robot.
5. To understand about various Sensors and their applications in robots.

COURSE CONTENT

UNIT – 1 Introduction: Automation and Robotics, brief history of robotics, social and economic aspects of robots, advantages and disadvantages of using robots in industries. An over view of Robots – present and future applications. Classification and structure of Robotic system: Classification, geometrical configurations, wrist and its motions, end effectors and its types, links and joints.

06 Hours

UNIT – 2 Robot drive system: Hydraulic, Electric and Pneumatic types of locomotion devices. Resolution, accuracy and repeatability, advantages and disadvantages of drive system. Control systems and components: Basic control system concepts and models, transformation and block diagram of spring mass system, controllers – ON and OFF, proportional, integral, proportional and integral, transient and response to second order system. Robot actuation and feedback components: position, velocity sensors, actuators. 08 Hours

UNIT – 3 Robot Arm Kinematics : Kinematics – Introduction, direct and inverse, kinematics, rotation matrix, composite rotation matrix, rotation matrix about an arbitrary axis, Euler angles representati0n, homogeneous transformations, links, joints and their parameters, D-H representation. Robot Arm Dynamics: Lagrange - Euler formulations – Joint velocities, kinetic energy, potential energy and motion equations of a robot manipulator.

09 Hours

UNIT – 4 Trajectory planning: Introduction, general considerations on trajectory planning, joint interpolated trajectories, 4-3-4 trajectory example. Planning of Cartesian path trajectories. Robot Programming: Introduction, manual teaching, lead through teaching, programming languages – AML and VAL (simple examples) programming with graphics, storing and operating task programs. 09 Hours

UNIT – 5 Sensors: Internal state sensors, tactile sensors, proximity sensing, range sensing, and force torque sensors. Elements of computer vision. Sensing and digitizing function in machine vision – image devices – lighting techniques, analog to digital conversion – sampling – quantization – encoding – image storage image processing and analysis, Feature Extraction and object recognition. 07 Hours

TEXT BOOKS

Industrial Robotics / Groover M P /Pearson Edu. 2. Robotics / Fu K S/ McGraw Hill.

REFERENCE BOOKS

1. Robotics, CSP Rao and V.V. Reddy, Pearson Publications (In press)
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.
3. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall

5. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
6. Introduction to Robotics / John J Craig / Pearson Edu.
7. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

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DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Subject Name & Code	PROJECT WORK IP83P
No. of Teaching Hours – 20	Credits : 0:0:10

Course Objective:

- To carry out real time projects in emerging areas of Design, Production, Thermal and Management Streams
- To convert ideas into realizable solution in the identified areas of I&PE domain
- To find or propose solutions for existing problems identified in the Manufacturing/Service or in social scenarios.

Description		
01	Students should identify the thrust areas of I&PE domain and must carry out a group project. The student batches should be formed during 7th semester Thorough literature review should be conducted to narrow down the project topic during 7th to 8th Semester break. Projects can carried out either in the Industries/organizations with proper permission from the respective guide(s) and HOD. A total of 3 presentations in 3 different phases have to be done during the course of the semester and the progress reports has to be submitted to the department.	20 Hrs

Phase – I report should include:

- Problem definition and Problem statement.
- Objective and Scope of the proposed Project work.
- Methodology of proposed Project work.
- Literature review and references.

Phase-II report should include:

- Work completed till date.
- Work in progress.
- Future work to be carried out.

Phase-III report should include:

- Detailed report of the project work
- Based on the area of work, students should submit:

Material specimen (if any), Design Prototype (if any), Layout design drawings (if any), related graphs, charts etc and other outcome on the day of evaluation.

Note: Students should refer to Peer reviewed journals for citing source and for literature review.

References: Project Report Guidelines Prepared by I&PE Department.

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