

Scheme of Teaching and Examination 2020-21
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ()

SEMESTER: III

Sl. No	Subject code	Course title	Category Code	Teaching Department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20MA310	Mathematics III	BSC	Mathematics	MATHS	3	0	0	3	3	50	50	100	03
2	20IP310	Industrial Metrology	PCC	IP	IP	4	0	0	4	4	50	50	100	03
3	20IP320	Kinematics of Machines	PCC	IP	IP	4	0	0	4	4	50	50	100	03
4	20IP330	Fluid Mechanics	PCC	IP	IP	4	0	0	4	4	50	50	100	03
5	20IP340	Elements of Production Engineering	PCC	IP	IP	4	0	0	4	4	50	50	100	03
6	20IP350L	Computer aided Machine Drawing	PCC	IP	IP	0	0	6	6	3	50	50	100	03
7	20IP37L	Industrial Metrology Lab	PCC	IP	IP	0	0	3	3	1.5	50	50	100	03
8	20IP38L	Elements of Production Engineering Lab	PCC	IP	IP	0	1	2	3	1.5	50	50	100	03
9	20EV310	Environmental Studies	HSMC	Environmental Engineering	ENV	0	0	0	0	0	50	-	50	-
		Total							Total credits	25	Total marks		850	

SWAYAM Courses

1.	Communication Skills (12 Weeks)
2.	Business Research Methods (12 Weeks)
3.	Consumer Behavior (12 Weeks)

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SCHEME OF TEACHING AND EXAMINATION FOR B.E ()
SEMESTER: IV

Sl. No	Subject code	Course title	Category Code	Teaching department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20MA410	Mathematics IV	BSC	Mathematics	MATHS	3	0	0	3	3	50	50	100	03
2	20IP410	Material Science & Metallurgy	PCC	IP	IP	3	0	0	3	3	50	50	100	03
3	20IP420	Dynamics of Machines	PCC	IP	IP	4	0	0	4	4	50	50	100	03
4	20IP430	Metal Cutting & Machine Tools	PCC	IP	IP	3	0	0	3	3	50	50	100	03
5	20IP440	Thermal Engineering	PCC	IP	IP	3	0	0	3	3	50	50	100	03
6	20IP450	Computer Aided Design	PCC	IP	IP	3	0	0	3	3	50	50	100	03
7	20HU410	Universal Human Values(UHV)	HSMC	IP	IP	2	0	0	2	2	25	25	50	1.5
8	20IP46L	Material Testing Lab	PCC	IP	IP	0	0	2	2	1	50	50	100	02
9	20IP47L	Metal Cutting & Machine Tools Lab	PCC	IP	IP	0	0	3	3	1.5	50	50	100	03
10	20IP48L	Computer Aided Design Lab	PCC	IP	IP	0	0	3	3	1.5	50	50	100	03
		Total							Total credits	25	Total marks		950	

SWAYAM Courses

1.	Computer Application in Business (12 Weeks)
2.	Organizing and Managing Information (12 Weeks)
3.	Condition Monitoring and Maintenance Management (8 Weeks) Design Thinking and Primer (4Weeks)

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SCHEME OF TEACHING AND EXAMINATION FOR B.E ()

SEMESTER: V

Sl. No	Subject code	Course title	Category Code	Teaching department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20IP510	Management & Entrepreneurship	PCC	IP	IP	4	0	0	4	4	50	50	100	03
2	20IP520	Design of Machine Elements.	PCC	IP	IP	4	0	0	4	4	50	50	100	03
3	20IP530	Product Design & Manufacturing	PCC	IP	IP	4	0	0	4	4	50	50	100	03
4	20IP540	Industrial Engineering & Ergonomics	PCC	IP	IP	4	0	0	4	4	50	50	100	03
5	20IP55x	Professional Elective-I	PEC	IP	IP	3	0	0	3	3	50	50	100	03
6	20IP56x	Open Elective-I	OEC	IP	IP	3	0	0	3	3	50	50	100	03
7	20IP57L	Industrial Engineering & Ergonomics lab	PCC	IP	IP	0	0	1.5	1.5	3	50	50	100	03
8	20IP58L	Computer Aided Engineering Analysis Lab	PCC	IP	IP	0	0	1.5	1.5	3	50	50	100	03
9	20HU510	Constitution of India	HSMC	Humanities	Humanities	0	0	0	0	2	50	-	50	-
		Total							Total credits	25	Total marks		850	

	Professional Elective-I		Open Elective-I	SWAYAM Courses
20IP551	Theory of Metal Forming	20IP561	Mechanics of Materials	Sustainability Science (12 Weeks)
20IP552	Non Destructive Testing	20IP562	Maintenance Engineering & Industrial Safety	Advanced Machining Processes (8 Weeks) Documents Processing and Organizations (4 Weeks)
20IP553	Marketing Management	20IP563	Energy Engineering & Management	Advanced Materials & Processes (12 Weeks)

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SEMESTER: VI

SCHEME OF TEACHING AND EXAMINATION FOR B.E ()

Sl. No	Subject code	Course title	Category Code	Teaching department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20IP610	Operations Research	PCC	IP	IP	4	0	0	4	4	50	50	100	03
2	20IP620	Applied Machine Design	PCC	IP	IP	4	0	0	4	4	50	50	100	03
3	20IP630	Quality Engineering	PCC	IP	IP	3	0	0	3	3	50	50	100	03
4	20IP65x	Professional Elective-II	PEC	IP	IP	3	0	0	3	3	50	50	100	03
5	20IP66x	Open Elective-II*	OEC	IP	IP	3	0	0	3	3	50	50	100	03
6	20IP67x	Open Elective-III*	OEC	IP	IP	3	0	0	3	3	50	50	100	03
7	20IP68L	Computer Aided Manufacturing Lab	PCC	IP	IP	0	0	3	3	1.5	50	50	100	03
8	20IP69L	Operation Research & Quality Engineering Lab	PCC	IP	IP	0	0	3	3	1.5	50	50	100	03
9	20IP70P	Mini Project	PCC	IP	IP	0	0	4	4	2	50	50	100	03
10	20HU520	Essence of Indian traditional knowledge***	Humanities	Humanities	Humanities	0	0	0	0	0	50	-	50	-
		Total							Total credits	25	Total marks		950	

Professional Elective-II		Open Elective-II		Open Elective-III		SWAYAM Courses
20IP651	Composite Materials	20IP661	Technical Communication and Professional Ethics	20IP671	Industrial Robotics	Advances in welding & Joining Technology (8Weeks)
20IP652	Non Traditional Machining	20IP662	Energy and Environment	20IP672	World Class Manufacturing	Microprocessor and Mechatronics in Swayam (12 Weeks)
20IP653	Lean & Agile Manufacturing	20IP663	Technology Management	20IP673	Data Base Management System	Intellectual Property Rights

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SCHEME OF TEACHING AND EXAMINATION FOR B.E ()

SEMESTER: VII

Sl. No	Subject code	Course title	Category Code	Teaching department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20IP710	Hydraulics & Pneumatics	PCC	IP	IP	3	0	0	3	3	50	50	100	03
2	20IP72x	Professional Elective-III	PEC	IP	IP	3	0	0	3	3	50	50	100	03
3	20IP73x	Professional Elective-IV	PEC	IP	IP	3	0	0	3	3	50	50	100	03
4	20IP74x	Open Elective-IV	OEC	IP	IP	3	0	0	3	3	50	50	100	03
5	20IP75x	Open Elective-V	OEC	IP	IP	3	0	0	3	3	50	50	100	03
6	20IP76I	Project Phase 1	PCC	IP	IP	0	0	3	3	3	50	50	100	03
7	20IP77T	Industrial training /Internship	PCC	IP	IP	0	0	2	2	1	50	---	50	----
									Total credits	19	Total marks		650	

Professional Elective-III		Professional elective-IV*		Open Elective-IV		Open Elective-V	
20IP721	Tool Engineering Design and Fixtures	20IP731	Plant Layout & Design	20IP741	Design for Manufacturing	20IP751	Human Resource Management
20IP722	Organizational Behavior	20IP732	Industry 4.0	20IP742	Energy Audit	20IP752	Purchasing & Materials Management
20IP723	Operations Management	20IP733	Mechanical Vibrations	20IP743	Management Information Systems	20IP753	Design Thinking



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SCHEME OF TEACHING AND EXAMINATION FOR B.E ()

SEMESTER: VIII

Sl. No	Subject code	Course title	Category Code	Teaching department	QP SETTING DEPT	CONTACT HOURS				CREDITS	Marks			Exam Duration in hrs.
						L	T	P	TOTAL		CIE	SEE	Total	
1	20IP81x	Professional Elective-V	PEC	IP	IP	3	0	0	3	3	50	50	100	03
2	20IP82x	Professional Elective-VI	PEC	IP	IP	3	0	0	3	3	50	50	100	03
3	20IP83P	Project work	PCC	IP	IP	`	`	-	-	10	70	30	100	03
		Total							Total credits	16	Total marks		300	

Professional Elective-V			Professional Elective-VI		
20IP811	Mechatronics		20IP821	Computer Integrated Manufacturing	
20IP812	Just in Time Manufacturing		20IP822	Design Thinking & Innovation	
20IP813	Engineering Economics		20IP823	Supply Chain Management	

- Note: 1. The evaluation of the project work shall be done in four phases. 70 % weightage shall be given for the performance of the student in 1st (20 Marks), 2nd (20 Marks) and 3rd phases (30 Marks) evaluation (CIE) and 30 Marks for 4th phase evaluation (SEE).**
- 2. Project Evaluation (Phase 1,2&3) should be done at the department Level Immediately after the 1st, 2nd and 3rd Theory test respectively.**
- 3. Three-member committee will be formed (including the guide) at the department level to evaluate the project progress in phase 1, 2 & 3. This same committee will evaluate and finalize the CIE in all the phases. (Committee should remain same except for special cases).**
- 4. Project team size can be 1-4.**
- 5. Classes for 8th Semester preferred to be conducted only on Saturdays from 7.30AM to 1.30PM. Students should be allowed to work in the Industry from Monday to Friday (Internship), which may or may not be linked to the Project Work.**

Category Code:

BSC – Basic Science Course

ESC – Engineering Science Course

PCC – Professional Core Course (Including Laboratory subjects)

PEC- Professional Elective Course

OEC- Open Elective Course

HSMC – Humanities Social Science and Management Course

PWC – Project Work Course

List of SWAYAM Courses identified by the department (for Professional Elective – IV):

(Students can complete 12 Weeks of SWAYAM course/s between 3-6th Semester to claim exemption for Elective - IV)

Sl. No.	SWAYAM Course Title	No of Weeks
1.	Communication Skills	12 Weeks
2.	Business Research Methods	12 Weeks
3.	Consumer Behavior	12 Weeks
4.	Computer Application in Business	12 Weeks
5.	Organizing and Managing Information	12 Weeks
6.	Sustainability Science	12 Weeks
7	Advanced Materials & Processes	12 Weeks
8	Microprocessor and Mechatronics in Swayam	12 Weeks
9	Advanced Machining Processes	8 Weeks
10	Advances in welding & Joining Technology	8 Weeks
11	Condition Monitoring and Maintenance Management	8 Weeks
12	Design Thinking and Primer	4 Weeks
13	Documents Processing and Organizations	4 Weeks
14	Intellectual Property Rights	
15		
16		
17		
18		
19		
20		

List of open electives offered by the department of and Engineering

Sl.No.	Semester :elective	Course Code	Course Title
1	5 : Open Elective – 1	20IP561	Technical Communication and Professional Ethics
2		20IP562	Maintenance Engineering & Industrial Safety
3		20IP563	Energy Engineering & Management
4	6 :Open Elective – 2	20IP661	Mechanics of Materials
5		20IP662	Energy and Environment
6		20IP663	Technology Management
7	6 :Open Elective – 3	20IP671	Industrial Robotics
8		20IP672	World Class Manufacturing
9		20IP673	Data Base Management System
10	7: Open Elective – 4	20IP741	Design for Manufacturing
11		20IP742	Energy Audit
12		20IP743	Management Information Systems
13	7: Open Elective - 5	20IP751	Industry 4.0
14		20IP752	Purchasing & Materials Management
15		20IP753	Fundamentals of Fracture Mechanics

Engineering Mathematics-III (Common to all branches)

Contact Hours/ Week	3(L)	Credits	3
Total Lecture Hours	39	CIE Marks	50
Total Tutorial Hours	00	SEE Marks	100
Sub Code	20MA310	Semester	III

Prerequisites: Engineering Mathematics-I and II.

Course objectives:

1. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
2. To introduce the basic concepts and applications of probability in engineering.
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations.
4. Learn to solve algebraic, transcendental and ordinary differential equations numerically.
5. Learn to represent a periodic function in terms of sine and cosine functions.

Course Outcomes: Upon completion of this course the student will be able to:

CO1:	Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data.
CO2:	Determine the nature of the events and hence calculate the appropriate probabilities of the events.
CO3:	Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations.
CO4:	Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data.
CO5:	Construct the Fourier series expansion of a function/tabulated data.

Chap. No.	Topics	Hrs
	UNIT - I	
01	Statistics :Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines	08 Hrs
	UNIT - II	
02	Random Variable : Discrete Probability distribution, Continuous Probability distribution, expectation, Variance, Moments, Moment generating function, Probability generating function, Binomial distribution, Poisson distribution, Normal distribution and Exponential distributions.	08 Hrs
	UNIT - III	
03	Partial differential equations (P.D.E.): Formation of Partial Differential Equation, Solution of Lagrange's Linear P.D.E. of the type $Pp+Qq=R$. Method of Separation of Variables. Applications of P.D.E.: Classification of PDE, solution of one dimensional heat and wave, two dimensional Laplace's equation by the method of separation of variables.	08 Hrs
	UNIT - IV	
04	Numerical solution of Ordinary differential equations: Taylor's series method, Euler's and modified Euler's method, fourth order Runge-Kutta method.	07 Hrs

	UNIT-V	
05	Fourier Series: Periodic functions, Fourier Expansions, Half Range Expansions, Complex form of Fourier series, Practical Harmonic Analysis	08 Hrs

Text Book:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
2. Ramana .B.V, "Higher Engineering Mathematics", latest edition, Tata-McGraw Hill, 2016

Reference Books:

1. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
2. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2015

Mapping Course Outcomes with Program outcomes & Program Specific outcomes

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	2	2											2		
CO3	2	2											2		
CO4	2	2											2		
CO5	2	2											2		

1---Low association, 2--- Moderate association, 3---High association

Course Title: Industrial Metrology	Course Code: 20IP310
Credits (L:T:P): 4:0:0	Total Contact Hours: 52:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the concept of standards of measurements and the various instruments, comparators, gauges and Nomenclature of threads
CO2:	Apply the concepts of Gauges, comparators, measuring devices for various force, pressure, torque, temperature, Strain Measurements etc.,
CO3:	Demonstrate the use of various measuring instruments through practical approach

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
	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. Instruments used for gear measurement and other surface 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, Alstutko, 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

Web Resources:

1. <https://nptel.ac.in/courses/112/106/112106179/>
2. <https://nptel.ac.in/courses/112/104/112104250/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				1		1				1	2		1
CO2	2	2				1		1				1	2		1
CO3	2	2				1		1				1	2		1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Kinematics of Machines	Course Code: 20IP320
Credits (L:T:P): 4:0:0	Total Contact Hours: 52:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able 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 of mechanisms using Grubler's criterion, contact ratio, maximum velocity of sliding and minimum number of teeth to avoid interference in gears etc.
CO3:	Analyze velocity and acceleration in mechanisms like four bar mechanism, slider crank mechanism, toggle mechanism, shaper mechanism etc. Analyze gears and gear trains.
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.

Unit No.	Course Content	No. of Hours
1	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. Mechanisms with lower pairs: Straight line motion mechanisms, pantograph, Toggle mechanism, Ackerman steering gear mechanism, intermittent motion mechanisms- Geneva mechanisms, Ratchet and pawl mechanism.	14
2	Velocity analysis of mechanisms: Introduction, absolute and relative motion of a link, angular velocity of links, four link mechanism, slider crank mechanism, crank and slotted lever mechanism, toggle mechanism. 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	13
3	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, synthesis of quick return mechanism, freudensteins method, Bloch's synthesis.	06

4	<p>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.</p> <p>Gear trains: Simple gear trains. Compound gear trains, reverted gear trains, Epicyclic gear trains. Tabular method of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.</p>	12
5	<p>Cams: Definition, types of followers, types of Cams, Cam terminology, Disc cam with reciprocating follower having knife edge, roller edge, spherical faced and flat faced followers, disc cam with oscillating roller follower. Displacement, velocity and acceleration diagrams for follower motions like Uniform velocity, Simple Harmonic Motion, uniform acceleration & retardation and cycloidal motion.</p>	07

Text Books:

1. Theory of Machines – J.K. Gupta and R.S. Khurmi, 14th edition, 2020
2. Theory of machines - Rattan S.S, Tata Mcgrew Hill Publishing company Ltd., 5th edition 2019.

Reference Books:

1. Theory of machines - A Sadhu Singh. -Pearson Edn 2002
2. Theory of machines - Thomas Bevan , CBS Publications 3rd edition, 2009
3. Theory of machines and mechanisms- Prof. P.L.Ballaney -Khanna Publications 2003.
4. Theory of Machines and Mechanisms – Ghosh & Mallik, East West Publications, 2008

Web Resources:

1. <https://nptel.ac.in/courses/112/104/112104121/>
2. <https://nptel.ac.in/courses/112/105/112105268/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										2		
CO2	3	3	2										3		
CO3	3	3	2										3		
CO4	3	3	3										3		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Fluid Mechanics	Course Code: 20IP330
Credits (L:T:P): 4:0:0	Total Contact Hours: 52:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the concept & properties of fluid and learn concept of fluid statics and estimate the variations of pressure in a static mass of fluid.
CO2:	Apply the concepts of various flow measurement devices like orifice meter, venturimeter etc with numerical problems with emphasis on Laminar and Turbulent flows
CO3:	Analyse the concepts of fluid Kinematics and Dynamics through various theorems and numerical relations

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.	06 Hrs
06	Fluid Flow measurements: Introduction, Venturimeter, orifice meter, pitot tube through pipes - Frictional loss in pipe flow, Darcy- Equation for loss of head friction in pipes, Chezy's equation for loss of head due to friction 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

Web Resources:

1. <https://nptel.ac.in/courses/112/105/112105269/>
2. <https://nptel.ac.in/courses/112/105/112105183/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				1							2		1
CO2	2	2				1							2		1
CO3	3	2	1										3		2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Elements of Production Engineering	Course Code: 20IP340
Credits (L:T:P): 4:0:0	Total Contact Hours: 52:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the concept of various manufacturing Processes like casting, moulding welding , brazing etc.
CO2:	Demonstrate various manufacturing processes with suitable case examples used in industrial practices
CO3:	Apply and analyse various Non Destructive testing methods with suitable case examples used in industrial practices

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 & riser 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 ₂ Mould, 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

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 Second edition.
2. **Manufacturing Process-I** - A.C.Niranjan – Pooja publications.
3. **Manufacturing Process-I** - Dr. K.Radhakrishna. Fifth Editions
4. **Manufacturing Process** - H.D.Ramachandra

REFERENCE BOOKS:

1. **“Process and Materials of Manufacturing”**, Roy A Lindberg, 4thEd.PearsonEdu. 2012
2. **“Manufacturing Technology”**, Serope Kalpakjian, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed.2012.

Web Resources:

1. <https://nptel.ac.in/courses/112/104/112104301/>
2. <https://nptel.ac.in/courses/112/107/112107078/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2	1	1
CO2	3	3										1	3	1	1
CO3	3	2	1									1	3	1	1

Course Title: COMPUTER AIDED MACHINE DRAWING	Course Code: 20IP350L
Credits (L:T:P): 0:0:3	Total Contact Hours:0:0:72
Type of Course: Practical	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: Computer Aided Engineering Graphics.

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand and Visualize the isometric view of an object and project its front view , top view and profile view with all the relevant dimensions and thread forms, thread terminology, sectional views of threads.
CO2:	Apply techniques necessary to complete engineering drawings of standard fasteners (nuts, bolts, screws).
CO3:	Apply the concepts of drawing in visualizing the design and Assembly

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 joints with single/double cover straps (Chain and Zigzag, using snap head 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 (Pedestal Bearing) 2. Screw jack (Bottle type) 3. Tailstock of lathe 4. Machine vice 5. Tool Head of a shaper	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.

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		3					1		1	3		1
CO2	3	3	2		2					1		1	3		1
CO3	3	3	2		2					1		1	3		1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Industrial Metrology Lab	Course Code: 20IP37L
Credits (L:T:P): 0:0:1.5	Total Contact Hours:0:0:39
Type of Course: Practical	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the use of various instruments
CO2:	Apply and evaluate the measuring instruments like Caliper, micrometer, comparator etc
CO3:	Use and analyze the various non contact devices in calibrating the instruments.

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	6 Hrs
4	Measurements of alignment using Autocollimator – straightness, flatness.	6 Hrs
5	Measurements of Screw thread Parameters using floating carriage micrometer (using two wire method)	6 Hrs
6	Comparators- mechanical & Electrical comparators and its applications	3 Hrs
7	Measurements of gear tooth profile using gear tooth vernier /gear tooth micrometer.	3 Hrs
8	Calibration of micrometer using slip gauges, Dial gauge	3 Hrs

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	2		
CO3	3	2										1	2		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Elements of Production Engineering Lab	Course Code: 20IP38L
Credits (L:T:P): 0:0.5:1	Total Contact Hours:0:0:39
Type of Course: Practical	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the basics of foundry and sheet metal practice.
CO2:	Apply the knowledge learnt and to prepare the various models of the same.
CO3:	Synthesize the knowledge learnt from the industry perspective.

Sl. No	Topics	Hrs
01	Foundry Laboratory: a. Permeability & Compression Tests on Foundry Sand & plot the characteristic Graphs. b. Practice classes on the preparation of moulds, mould cavity using manual type & patterns. Note: 4 models have to be prepared.	6Hrs Lecture 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 folded joints. Note: 4 Models have to be prepared.	9 Hrs Lecture 12 Hrs Lab

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	3		
CO3	3	2										1	3		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Engineering Mathematics-IV (Common to all branches)

Contact Hours/ Week	3(L)	Credits	3
Total Lecture Hours	39	CIE Marks	50
Total Tutorial Hours	00	SEE Marks	100
Sub Code	20MA410	Semester	IV

Prerequisites: Engineering Mathematics-I and II.

Course objectives:

1. Learn the concepts of finite differences, interpolation and their applications.
2. Evaluate Fourier transforms and use Z-transform to solve difference equations
3. Understand the concepts of calculus of functions of complex variables.
4. Understand the concepts of calculus of functions of complex variables.
5. To make the student to solve system of linear equations, carryout matrix operations, determine the eigenvalues & eigenvectors.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data.
CO2	Evaluate Fourier transforms and use Z-transform to solve difference equations
CO3	Examine and construct the analytic functions.
CO4	Classify singularities of complex functions and evaluate complex integrals.
CO5	Ability to solve system of linear equations, carryout matrix operations, determines the Eigen values & eigenvectors.

Sl. No	Topics	Hrs
	UNIT-I	
01	Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems	07 Hrs
	UNIT-II	
02	Fourier Transforms: Finite and Infinite Fourier transform, basic properties, convolution theorem; inverse transforms; Z-transforms: z-transforms and inverse z-transforms; solution of difference equation	08 Hrs
	UNIT – III	
03	Complex Variables-I: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions.	08 Hrs
	UNIT-IV	
04	Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series (statements only), Singularities, Poles and residues, Cauchy residue theorem.	08 Hrs

UNIT-V		
05	Linear Algebra: System of linear equations, Row operations, Echelon form Reduced Echelon form, Solution of Homogeneous and Non homogeneous equations, vector equations, Linear combinations, Linear independent/dependent vectors, Eigen values, Eigen vectors, Diagonalizations, Solving a system of differential equations using diagonalization.	08 Hrs

Text Book:

3. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
4. Ramana .B.V, "Higher Engineering Mathematics", latest edition, Tata-McGraw Hill, 2016
- 5.
6. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 4th Edition, PHI/Pearson Education, 2005.

Reference Books:

4. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
5. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
6. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill 2014.
7. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 4th Edition, PHI/Pearson Education, 2005.

Mapping Course Outcomes with Program outcomes & Program Specific outcomes

Course Outcomes	Program Outcomes												PSO's		
	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
CO1	2	2											2		
CO2	2	2											2		
CO3	2	2											2		
CO4	2	2											2		
CO5	2	2											2		

1---Low association, 2--- Moderate association, 3---High association

Course Title: MATERIAL SCIENCE & METALLURGY	Course Code: 20IP410
Credits (L:T:P): 3:0:0	Total Contact Hours:39:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the structure and diffusion concepts and to correlate with the material properties, Behaviour of Materials, Equilibrium Diagrams, TTTdiagram & other phases of solids
CO2:	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
CO3:	To apply metallurgical concepts of various heat treatment processes like Normalizing, Annealing, Tempering, Hardening and quenching etc in industrial practices

Chap. No.	Topics	Hrs
UNIT I		
01	Structure of solids: classification, Bravais space lattice, Miller indices. Problems related to density calculation. Crystal Imperfections.	04 Hrs.
02	Diffusion: Mechanism, Fick's 1 st and 2 nd Laws of diffusion, types of diffusion Factors affecting diffusion, Application.	04 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 and true strain plastic deformation by slip and twinning strain hardening, re-crystallization and grain growth	04 Hrs
04	Fracture, Fatigue and Creep: Fracture toughness, 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.	03 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	05 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.	8 Hrs
UNIT V		
07	Heat treatment of Steels: Need, purpose, process- annealing, normalizing, hardening, tempering , martempering, austempering, hardenability, surface heat treatments- carburizing, nitriding and cyaniding.	04 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.	03 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

Web Resources:

1. <https://nptel.ac.in/courses/113/106/113106101/>
2. <https://nptel.ac.in/courses/113/104/113104096/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	3		
CO3	3	2										1	3		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Dynamics of Machines	Course Code: 20IP420
Credits (L:T:P): 4:0:0	Total Contact Hours: 52:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 100

Course Outcomes:

At the end of the course the student will be able 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. Perform vibration analysis of real word systems to reduce imbalance and shaking forces of rotating and reciprocating parts. Analyze the motion of followers (roller and flat faced) for cams with specified contour.
CO4	

Chap. No.	Topics	Hrs
UNIT I		
01	Static Force Analysis: Introduction, Reaction between members, transmission of forces, analysis of engine mechanism, engine force analysis- 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

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 Free torsional vibration-single rotor, multi-rotor systems - 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 Mechanisms by Shigley J.V. Vickers J.J oxford university press 2021
2. Worked examples in Theory of Machines –J.S.Rao

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. Dynamics of Machinery –Holovenko

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									1	2		
CO2	3	3	2									1	3		
CO3	3	3	2									1	3		

No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: METAL CUTTING & MACHINE TOOLS	Course Code: 20IP430
Credits (L:T:P): 3:0:0	Total Contact Hours:39:0:0
Type of Course: <i>Lecture</i>	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand various metal cutting operations, properties and concepts of different types of cutting tool materials & cutting fluids and working concepts of turning machine drilling machine, shaping machine and milling machine and grinding machine and its operations
CO2:	Apply the concepts in the Manufacture of parts and components from the industrial perspectives
CO3:	Formulate various setups and illustrative schemes in the running of Machine Tools.

Chap. No.	Topics	Hrs
UNIT I		
01	Theory of Metal Cutting: Single point cutting tool nomenclature, geometry, Identification of tool inserts and tool holders Characteristics graphs on the effects of cutting conditions on Metal Removal Rate (MRR), concept of Machinability. orthogonal and oblique cutting, Mechanism of chip formation, types of chips, Merchant circle diagram, shear angle relationship, Problems	07 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 problems on tool life, Heat generation in metal cutting, factors affecting heat generation, measurement of tool tip temperature	05 Hrs
04	Cutting Fluids: Types & properties of cutting fluids and selection., characteristic graphs of the effects of cutting fluids on Metal Removal Rate (MRR).	03 Hrs
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.	04 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	03 Hrs
UNIT V		
09	Grinding Machines: Classification, constructional features, Specification of Grinding wheel, Selection of Grinding wheels, Types of Abrasives, bonding process, Centerless Grinding Machines & its applications	04 Hrs
10	Super finishing process: Honing, lapping and super finishing operations, tools, working principles, applications with case examples	03 Hrs

TEXT BOOKS:

1. **Production Technology:** HMT – Tata McGraw Hill
2. **Production Technology:** R.K.Jain, Khanna Publications

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. **Manufacturing Process and materials of manufacture:** Roy A. Lindberg Prentice Hall of India,
5. **Fundamentals of metal machining and machine tools:** G. Boothroyd, McGrawHill
6. **Metal cutting and tool design:** Dr. B.J. Ranganath – VikasPublications.

Web Resources:

1. <https://nptel.ac.in/courses/112/105/112105233/>
2. <https://nptel.ac.in/courses/112/105/112105306/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2	1	1
CO2	3	3										1	3	1	1
CO3	3	2										1	3	1	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: THERMAL ENGINEERING	Course Code: 20IP440
Credits (L:T:P): 3:0:0	Total Contact Hours:39:0:0
Type of Course: <i>Lecture</i>	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the basic concepts of Thermodynamics and to apply the principles of first and second laws of Thermodynamics and the principles prevailing in perfect gases and to study the various characteristics of different thermodynamic processes
CO2:	Apply & Analyse the working principles of air compressors, Nozzles with numerical problems.
CO3:	Evaluate the air standard and vapour power cycles with numerical examples.

Chap. No.	Topics	Hrs
UNIT I		
01	Basic concepts: Systems surroundings, Universe, properties of system. First Law of thermodynamics: Internal Energy and Enthalpy, Problems	04 Hrs.
02	Second law of Thermodynamics: Heat engines and Heat pump. Efficiency and co-efficient of performance. Reversible and irreversible process, entropy.	03 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 heated vapour, 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	08 Hrs.
UNIT III		
04	Air compressors - Reciprocating and rotary compression, work of compression for single stage and multistage compression. Effect of clearance volume on the performance of reciprocating compressors, Problems	07 Hrs
UNIT IV		
05	Air Standard cycles: Derivations of Carnot, Otto, diesel, Dual combustion, 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	05 Hrs

UNIT V		
07	Steam Nozzles: Definition, Types of Nozzles, Function of steam nozzles, working of steam nozzle, Factors affecting nozzle efficiency, selection criteria of nozzle, Application of steam nozzles, Velocity of steam flowing through a nozzle, effect of friction and conditions for maximum discharge through a nozzle. Supersaturated flow of Steam- Numerical Problems	06 Hrs

TEXT BOOKS :

1. **Basic and applied thermodynamics** – P.K. Nag , Tata Mcgrawhill Publications
2. **Engineering Thermodynamics with applications** – David Burgardt

REFERENCE BOOKS:

1. **Thermodynamics** by VAN WYLEN & R.E Sontang Wiley Eastern
2. **Thermodynamics** by GUPTHA & Rajendraprakash
3. **Thermodynamics & Heat Engines** by Domkundwar
4. **Thermodynamics worked examples** – Y.A.C. Rao, IIT Delhi
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. Laroia, Birla Pub. Pvt. Ltd., Delhi, 2008

Web Resources:

1. <https://nptel.ac.in/courses/112/105/112105266/>
2. <https://nptel.ac.in/courses/112/104/112104113/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		1
CO2	3	3										1	3		1
CO3	3	2										1	3		1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: COMPUTER AIDED DESIGN	Course Code: 20IP450
Credits (L:T:P): 3:0:0	Total Contact Hours:39:0:0
Type of Course: Lecture	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the concept of Computer aided design features
CO2:	Apply the knowledge of CAD in arriving at possibilities of Boolean operations and to tackle the same using model tree and exchange of platforms
CO3:	Synthesis the overall feature in arriving at practical applications of industry front

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	04
2	Hardware for CAD: Usage and types of hardware for CAD – input devices, display devices, printing , plotting devices and other hardware interface devices	04
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. 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, viewing features.	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,	07

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 BOOKS

1. CAD/CAM principles and applications by P N Rao
2. CAD/CAM by Groover,

REFERENCE BOOKS

1. Introduction to design & analysis of algorithms - S.E.Goodman, S.T.Headetmiemi
2. Principles of interactive computer graphics by Newman & Sproul
3. Computer graphics by Steven Harrington
4. CAD-CAM by ChrisMcMahon& JimmieBrowne
5. CAD-CAM by IbrahimZeid

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

Web Resources:

1. <https://nptel.ac.in/courses/112/104/112104031/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2								1		1	2		1
CO2	3	3								1		1	3		1
CO3	3	2	1							1		1	3		1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: UNIVERSAL HUMAN VALUES 2	Course Code: HSMC (H-102)
Credits (L:T:P): 2:0:0	Total Contact Hours: 26:0:0
Type of Course: Lecture	Category: Humanities Social Science and Management Course
CIE Marks: 25	SEE Marks: 25

Pre-requisite: None. Universal Human Values-I (desirable)

Course Outcomes: After completing this course, students should be able to:

CO1:	Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, keeping human relationships and human nature in mind.
CO2:	Have better critical ability and also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

Unit No.	Course Content	No. of Hours
1	<p>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>1. Purpose and motivation for the course, recapitulation from Universal Human Values-I</p> <p>2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration</p> <p>3. Continuous Happiness and Prosperity- A look at basic Human Aspirations</p> <p>4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority</p> <p>5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</p> <p>6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</p>	14
2	<p>Understanding Harmony in the Human Being - Harmony in Myself!</p> <p>7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</p> <p>8. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility</p> <p>9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</p> <p>10. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</p> <p>11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail</p> <p>12. Programs to ensure Sanyam and Health.</p>	13
3	<p>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship</p> <p>13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship</p> <p>14. Understanding the meaning of Trust; Difference between intention and competence</p> <p>15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship</p> <p>16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals</p> <p>17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.</p>	06
4	<p>Understanding Harmony in the Nature and Existence - Whole existence as Coexistence</p>	12

	18. Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature 20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space 21. Holistic perception of harmony at all levels of existence.	
5	Implications of the above Holistic Understanding of Harmony on Professional Ethics 22. Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 26. Case studies of typical holistic technologies, management models and production systems 27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations 28. Sum up.	07

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Web Resources:

1. <https://onlineethics.org/>
2. <https://nptel.ac.in/courses/109/104/109104068/>

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1	2	2				1			
CO2						1	1	1				1			

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: MATERIAL TESTING LAB	Course Code: 20IP46L
Credits (L:T:P): 0:0:1	Total Contact Hours:0:0:26
Type of Course: <i>Practical</i>	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the properties of materials like hardness , toughness, strength, stiffness etc
CO2:	Use the various testing devices to measure hardness, impact strength, tensile strength, bending and shear strength , Compressive of metallic and non metallic materials.

Sl. No	Topics	Hrs
1	Hardness Test: Estimating the Hardness of different Engineering materials Using Brinell's& Rockwell Hardness Testers.	06 Hrs
2	Impact Test: Determining the impact strength for a given material using Charpy& IZOD tests.	04 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.	04 Hrs

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	3		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: METAL CUTTING AND MACHINE TOOL LAB	Course Code: 20IP47L
Credits (L:T:P): 0:0:1.5	Total Contact Hours:0:0:39
Type of Course: <i>Practical</i>	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the various Operations in lathe involving plain, taper and step turning, thread cutting, eccentric turning and understand the acceptance criteria of lathe, shaping machine, milling machine
CO2:	Use the various Machine Tools to perform model exercises and a measure the various forces acting on the machines.

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.	27 Hrs
02	Cutting of V Groove / Rectangular groove using a shaper.	06 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

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	3		

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: COMPUTER AIDED DESIGN LAB	Course Code: 20IP48L
Credits (L:T:P): 0:0:1.5	Total Contact Hours:0:0:39
Type of Course: <i>Practical</i>	Category: Professional Core Course
CIE Marks: 50	SEE Marks: 50

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO1:	Understand the concepts of Primitives, 2D, 3 D drawings
CO2:	Apply the various commands like Model Tree, Reorder and other surface modeling features

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

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	2		
CO2	3	3										1	3		