COURSE STRUCTURE & SYLLABUS

For

B.Tech.

MECHANICAL ENGINEERING

(*Applicable for batches admitted from 2020-21*)

PRAGATI ENGINEERING COLLEGE

(AUTONOMOUS)

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
1-378, ADB Road, Surampalem – 533 437
Near Peddapuram, E.G.Dist, Andhra Pradesh

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

⇨ Ragging within or outside any educational institution is prohibited.

⇨ Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

LET US MAKE PRAGATI RAGGING FREE COLLEGE

ABSOLUTELY NO TO RAGGING

1. **Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**
2. **Ragging entails heavy fines and/or imprisonment.**
3. **Ragging invokes suspension and dismissal from the College.**
4. **Outsiders are prohibited from entering the College and Hostel without permission.**
5. **Girl students must be in their hostel rooms by 7.00 p.m.**
6. **All the students must carry their Identity Cards and show them when demanded**
7. **The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**

LET US MAKE PRAGATI RAGGING FREE COLLEGE

VISION AND MISSION OF THE COLLEGE

VISION

To Emerge as a Premier Institution for Technical Education in the Country through Academic Excellence and to be Recognized as a Centre for Excellence in Research & Development, Catering to the needs of our Country.

MISSION

To realize a strong Institution by consistently maintaining State-of-art-Infrastructure and building a cohesive, World Class Team and provide need based Technical Education, Research and Development through enhanced Industry Interaction.

VISION AND MISSION OF THE DEPARTMENT

VISSION:

To be a globally renowned school of mechanical engineering in transforming individuals into professional engineers with world class competency and state-of-the-art research to fulfil the technological needs of the society.

MISSION:

The department of mechanical engineering strives.
M1: To prepare, educate and guide students by the faculty from all domains of mechanical engineering in enhancing their skills.
M2: To establish and utilize world class resources and infrastructure to impart quality education and promote Research aptitude among faculty and students to pursue higher education in diverse fields.
M3: To explore the students' knowledge gradually through industrial interaction for increasing their placement potential to fulfil the basic needs of the society with ethical and social responsibility.

PROGRAM EDUCATIONAL OBJECTIVES

PEO-1: Apply technical knowledge in the domain of core engineering and allied disciplines contributing to society through interdisciplinary expertise.

PEO-2: Strengthen technical competence by enhancing their self-learning capacity throughout their professional career as well as to pursue higher education.

PEO-3: Explore their artistry in emerging areas of engineering flourishing their leadership qualities pertaining to ethical innovation with social responsibility.

PROGRAM OUTCOMES (POs)

After successful completion of the program, the graduates will be able to

PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
PO2	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	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 multidisciplinary environments.
PO12	Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO-1	To solve engineering problems through delineation and perusal relating to mechanical systems and other allied engineering streams with / without advanced software tools.
PSO-2	To work solitary / array in developing core and multidisciplinary concepts for effective utilization of resources ensuring the best practices in the relevant.

Bloom's Taxonomy Knowledge Level	**Knowledge Level Representation**
Remember	K1
Understand	K2
Apply	K3
Analyze	K4
Evaluate	K5
Create	K6

Mapping/correlation levels
1: Low
2: Medium
3. High

COURSE STRUCTURE

Zero Semester

Induction program (mandatory)	**3 weeks duration**
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch and Innovations

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days. We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.2 The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

I YEAR – I SEMESTER

Sl. No	Category	Course Code	Course Title	L	T	P	Credits
1	BSC	20HE1T01	Professional Communicative English	3	0	0	3
2	BSC	20BM1T01	Differential Equations and Numerical Methods	3	0	0	3
3	BSC	20BP1T01	Engineering Physics	3	0	0	3
4	ESC	20CS1T01	Programming for Problem Solving using C	3	0	0	3
5	PCC	20ME1T02	Engineering Drawing	1	0	4	3
6	BSC	20HE1L01	Professional Communicative English Lab	0	0	3	1.5
7	BSC	20BP1L01	Engineering Physics Laboratory	0	0	3	1.5
8	ESC	20CS1L01	Programming for Problem Solving using C Laboratory	0	0	3	1.5
9	BSC	20BE1T01	Environmental Science	3	0	0	0
Total Credits							**19.5**

I YEAR – II SEMESTER

Sl. No	Category	Course Code	Course Title	L	T	P	Credits
1	BSC	20BM2T02	Linear Algebra and Partial Differential Equations	3	0	0	3
2	BSC	20BC2T01	Engineering Chemistry	3	0	0	3
3	PCC	20ME2T01	Engineering Mechanics	3	0	0	3
4	ESC	20EE2T01	Basic Electrical and Electronics Engineering	3	0	0	3
5	PCC	20ME2L03	Computer Aided Engineering Drawing	2	0	2	3
6	PCC	20ME2L01	Engineering Workshop Laboratory	0	0	3	1.5
7	BSC	20BC2L01	Engineering Chemistry Laboratory	0	0	3	1.5
8	ESC	20EE2L01	Basic Electrical and Electronics Engineering lab	0	0	3	1.5
9	BSC	20HE2T05	Constitution of India	2	0	0	0
Total Credits							**19.5**

II YEAR I SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	Credits
1	BSC	20BM3T03	Transforms and Vector Calculus	3	0	0	3
2	PCC	20ME3T04	Thermodynamics	3	0	0	3
3	PCC	20ME3T05	Metallurgy and Material Science	3	0	0	3
4	PCC	20ME3T06	Mechanics of Solids	3	0	0	3
5	PCC	20ME3T07	Fluid Mechanics & Hydraulic Machines	3	0	0	3
6	PCC	20ME3L04	Metallurgy and Material Science Laboratory	0	0	3	1.5
7	PCC	20ME3L05	Mechanics of Solids Laboratory	0	0	3	1.5
8	PCC	20ME3L06	Fluid Mechanics and Hydraulic Machinery Laboratory	0	0	3	1.5
9	SOC	20ME3S01	Basics of Applied Robot Control	0	0	4	2
10	MC	20HM3T06	Essence of Indian Traditional Knowledge	2	0	0	0
Total Credits							**21.5**

II YEAR II SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	Credits
1	BSC	20BM4T04	Complex Variables and Statistical Methods	3	0	0	3
2	PCC	20ME4T08	Applied Thermodynamics	3	0	0	3
3	PCC	20ME4T09	Kinematics of Machinery	3	0	0	3
4	PCC	20ME4T10	Production Technology	3	0	0	3
5	PCC	20ME4T11	Machine Drawing	3	0	0	3
6	PCC	20ME4L07	Drafting and Modelling Laboratory	0	0	3	1.5
7	PCC	20ME4L08	Thermal Engineering Laboratory	0	0	3	1.5
8	PCC	20ME4L09	Production Technology Laboratory	0	0	3	1.5
9	SOC	20CS4S08	Numerical Methods through Python	0	0	4	2
Total Credits							**21.5**
Internship 2 Months (Mandatory) during summer vacation							

III YEAR – I SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	C
1	PCC	20ME5T12	Dynamics of Machinery	3	0	0	3
2	PCC	20ME5T13	Design of Machine Members-I	3	0	0	3
3	PCC	20ME5T14	Machining, Machine Tools and Metrology	3	0	0	3
4	**Professional Elective-I**						
	PEC	20ME5T15	Industrial Engineering and Management	3	0	0	3
	PEC	20ME5T16	Automation in Manufacturing	3	0	0	3
	PEC	20ME5T17	Advanced Materials	3	0	0	3
	PEC	20ME5T18	Nano Technology	3	0	0	3
	PEC	20ME5O01	MOOCs(NPTEL/SWAYAM) course (12 week Duration)	3	0	0	3
5	**Open Elective-I**						
	OEC	20CE5T01	Surveying	3	0	0	3
	OEC	20EE5T13	Renewable Energy Engineering	3	0	0	3
	OEC	20EC5T15	Principles of Communication Engineering	3	0	0	3
	OEC	20AM5T04	Deep Learning	3	0	0	3
	OEC	20HM5T03	Entrepreneurship	3	0	0	3
6	PCC	20ME5L10	Machine Tools Laboratory	0	0	3	1.5
7	PCC	20ME5L11	Theory of Machines Laboratory	0	0	3	1.5
8	SOC	20HE5S01	Soft skills and inter personal communication	1	0	2	2
9	MC	20HM5T07	Professional Ethics and Human Values	2	0	0	0
10	#PROJ	20ME5I01	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester	0	0	0	1.5
11	Project	20ME5P01	Community Service Project	0	0	0	4
Total Credits							**25.5**

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	**4**	**0**	**0**	**4**

III YEAR – II SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	C
1	PCC	20ME6T19	Design of Machine Members-II	3	0	0	3
2	PCC	20ME6T20	Heat Transfer	3	0	0	3
3	PCC	20AM6T03	Introduction to Artificial Intelligence and Machine Learning	3	0	0	3
4	**Professional Elective-II**						
	PEC	20ME6T21	Operations Research	3	0	0	3
	PEC	20ME6T22	Automobile Engineering	3	0	0	3
	PEC	20ME6T23	Industrial Robotics	3	0	0	3
	PEC	20ME6T24	Statistical Quality Control	3	0	0	3
	PEC	20ME6O02	MOOCs(NPTEL/SWAYAM) course (12 week Duration)	3	0	0	3
5	**Open Elective-II**						
	OEC	20CE6T40	Disaster Management	3	0	0	3
	OEC	20EE6T19	Fundamentals of Electric Vehicles	3	0	0	3
	OEC	20EC6T26	Sensors and Transducers	3	0	0	3
	OEC	20CS6T15	Computer Forensics	3	0	0	3
6	PCC	20ME6L12	Heat Transfer Laboratory	0	0	3	1.5
7	PCC	20ME6L13	Metrology and Instrumentation Laboratory	0	0	3	1.5
8	PCC	20ME6L14	CAE and CAM Laboratory	0	0	3	1.5
9	SOC	20AM6S02	Artificial Intelligence and Machine Learning Laboratory	1	0	2	2
10	MC	20HM6T10	Research Methodology	2	0	0	0
Total Credits							**21.5**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation							

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	**4**	**0**	**0**	**4**

IV YEAR – I SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	C
1	**Professional Elective III**						
	PEC	20ME7T26	Power Plant Engineering	3	0	0	3
	PEC	20ME7T27	Finite Element Methods	3	0	0	3
	PEC	20ME7T28	Additive Manufacturing	3	0	0	3
	PEC	20ME7T29	Optimization Techniques	3	0	0	3
	PEC	20ME7O03	MOOCs(NPTEL/SWAYAM) course (12 week Duration)	3	0	0	3
2	**Professional Elective IV**						
	PEC	20ME7T30	Refrigeration and Air-conditioning	3	0	0	3
	PEC	20ME7T31	Condition Monitoring	3	0	0	3
	PEC	20ME7T32	Design for Manufacturing	3	0	0	3
	PEC	20ME7T33	CAD/CAM	3	0	0	3
	PEC	20ME7O04	MOOCs(NPTEL/SWAYAM) course (12 week Duration)	3	0	0	3
3	**Professional Elective V**						
	PEC	20ME7T34	Gas Dynamics and Jet Propulsion	3	0	0	3
	PEC	20ME7T35	Unconventional Machining Processes	3	0	0	3
	PEC	20ME7T36	Non-Destructive Evaluation	3	0	0	3
	PEC	20ME7T37	Production Planning and Control	3	0	0	3
	PEC	20ME7O05	MOOCs(NPTEL/SWAYAM) course (12 week Duration)	3	0	0	3
4	**Open Elective-III**						
	OEC	20CE7T11	Highway Engineering	3	0	0	3
	OEC	20EE7T29	Battery Management Systems and Charging Stations	3	0	0	3
	OEC	20EC7T40	Industrial Electronics	3	0	0	3
	OEC	20DS7T02	Big Data Analytics	3	0	0	3
	OEC	20HM7T09	Organizational Behavior	3	0	0	3
5	**Open Elective-IV**						
	OEC	20CE7T18	Water Resource Engineering	3	0	0	3
	OEC	20EE7T30	Smart Grid Technologies	3	0	0	3
	OEC	20EC7T41	Biomedical Instrumentation	3	0	0	3
	OEC	20IT7T10	Cryptography and Network Security	3	0	0	3
	OEC	20HM7T04	Marketing Management	3	0	0	3
6	BSC	20HM7T11	Universal Human Values-II Understanding Harmony	3	0	0	3
7	SOC	20ME7S02	Mechatronics Laboratory	0	0	4	2
8	#PROJ	20ME7I02	Industrial/Research Internship 2 Months (Mandatory) after III Year (to be evaluated during VII semester)	0	0	0	3
Total Credits							**23**

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	**4**	**0**	**0**	**4**

IV YEAR – II SEMESTER

S. No.	Category	Course Code	Course Title	L	T	P	C
1	Project Work	20ME8P02	Project Work	0	0	0	8
Total Credits							**8**
Total Credits (19.5 + 19.5 + 21.5 + 21.5 + 21.5+ 21.5 + 23 + 12)							**160**

I Year I Semester
Professional Communicative English
(Common to CE, EEE, MECH, ECE, CSE, CSE (DS), CSE (AI&ML), & IT)

Course Category	Basic Sciences	**Course Code**	20HE1T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Emphasizes that the ultimate aim of Education is to enhance wisdom and inspires the readers to serve their nation with their self-enrichment.	K2
CO2	Enables the learners to promote peaceful co-existence and universal harmony in society and empowers them to initiate innovation.	K2
CO3	Imparts the students to manage different cultural shock due to globalization and develop multiculturalism to appreciate diverse cultures and motivate them to contribute to their nation.	K3
CO4	Arouses the thought of life to lead in the right path by recognizing the importance of work besides enhancing their LSRW skills.	K2
CO5	Inspires the learners at the advancement of software by the eminent personalities and motivates the readers to think and tap their innate talents.	K2

K1- Remembering, K2- Understanding, K3-Applying, K-4 Analyzing, K5- Evaluating, K6- Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	2	-	3	-	-	-	-
CO3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	2	-	-

COURSE CONTENT

UNIT 1:

1. ‘The Greatest Resource- Education' from Professional Communicative English.
   Objective: Schumacher describes the education system by saying that it was mere training, something more than knowledge of facts.
   Outcome: Underscores that the ultimate aim of Education is to enhance wisdom.
2. 'War' from ‘Panorama: A Course on Reading'
   Objective: To develop extensive reading skill and comprehension for pleasure and profit.
   Outcome: Acquisition of LSRW skills

UNIT 2:

1. 'A Dilemma' from Professional Communicative English.
   Objective: The lesson centres on the pros and cons of the development of science and

technology.
Outcome: Enables the students to promote peaceful co-existence and universal harmony among people in society.

2. 'The Verger' from 'Panorama: A Course on Reading'
   Objective: To develop extensive reading skill and comprehension for pleasure and profit.
   Outcome: Acquisition of LSRW skills

UNIT 3:

1. 'Cultural Shock': Adjustments to new Cultural Environments from Professional Communicative English.
   Objective: Depicts of the symptoms of Cultural Shock and the aftermath consequences
   Outcome: Enables the students to manage different cultural shocks due to globalization.
2. 'The Scarecrow' from Panorama: A Course on Reading
   Objective: To develop extensive reading skill and comprehension for pleasure and profit.
   Outcome: Acquisition of LSRW skills

UNIT 4:

1. 'The Secret of Work' from Professional Communicative English.
   Objective: Portrays the ways of living life in its real sense.
   Outcome: Arouses the thought to lead life in a right path by recognizing the importance of work.
2. 'A Village Lost to the Nation' from Panorama: A Course on Reading
   Objective: To develop extensive reading skill and comprehension for pleasure and profit.
   Outcome: Acquisition of LSRW skills

UNIT 5:

1. 'The Chief Software Architect' from Professional Communicative English.
   Objective: Supports the developments of technology for the betterment of human life.
   Outcome: Pupil gets inspired by eminent personalities who toiled for the present-day advancement of software development.
2. 'Martin Luther King and Africa' from Panorama: A Course on Reading
   Objective: To develop extensive reading skill and comprehension for pleasure and profit.
   Outcome: Acquisition of LSRW skills

DETAILED TEXTBOOK:

1. **PROFESSIONAL COMMUNICATIVE ENGLISH** Published by Maruthi Publishers.

NON-DETAILED TEXTBOOK:

2. **PANORAMA: A COURSE ON READING**, Published by Oxford University Press India

The course content, along with the study material, is divided into six units.

I Year I Semester
Differential Equations and Numerical Methods
(Common to CE, EEE, ME, ECE, CSE, CSE-DS, CSE-AI&ML& IT)

Course Category	Basic Sciences	**Course Code**	20BM1T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Differentiation, Integration	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	solve first order differential equations and its applications	K3
CO2	solve the linear differential equations with constant coefficients by appropriate method	K3
CO3	apply Newton, Gauss and Lagrange interpolation formulae to find interpolating polynomials for the given data.	K3
CO4	find the approximate roots of transcendental equations by using different numerical methods	K2
CO5	solve initial value problems by using different numerical schemes	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT

UNIT I
CRYSTALLOGRAPHY & X-RAY DIFFRACTION

Introduction-Basis and lattice – Unit cell - Coordination number -Packing fraction - Bravais lattice-Crystal Systems – packing fractions of SC, BCC and FCC-Crystal directions and planes-Miller indices – Separation between successive (h k l) planes – Bragg's law - Bragg's X-ray spectrometer.

UNIT II
MAGNETIC PROPERTIES

Introduction-Magnetic-dipole-moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials(Analytical) – Wiess Domain theory - Hysteresis-B-H Curve- soft and hard magnetic materials - applications

DIELECTRICS

Introduction - Dielectic polarization– Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations- Electronic Ionic and Orientational polarizations (qualitative) – Lorentz Internal field – Claussius-Mossoti equation -Applications of dielectrics.

UNIT III
ACOUSTICS

Introduction –Conditions for a good Hall- Reverberation - Reverberation time - Sabine's formula (Jaggers' Method using Eyrings approximation)–absorption coefficient and its determination- factors affecting acoustics of buildings and their remedies.

ULTRASONICS

Introduction-Production of ultrasonic's by Magneto-striction and piezoelectric methods – Detection of ultrasonic's- Non-Destructive Testing- pulse echo system through transmission and reflection modes - Applications.

UNIT IV
LASERS

Introduction-Characteristics–Spontaneous and Stimulated emission of radiation – population inversion - Pumping Mechanisms - Ruby laser – Helium Neon laser –Semiconductor laser– Applications

SENSORS (Qualitative description only):

Introduction-Strain and Pressure sensors-Piezoelectric-Magnetostrictive sensors- Temperature sensor-smoke and fire detectors-Applications.

UNIT V
PHYSICS OF NANOMATERIALS

Introduction to Basics of Nano materials, Properties - Preparation methods (Sol Gel Technique, Ball Milling) and characterization Methods Scanning tunneling Microscopy, Atomic Force Microscopy – CNTs Preparation (Arc Discharge method) and properties - Applications of NanoMaterials (CNTs).

TEXT BOOKS

1. "A text book of Engineering Physics" by P G Kshirsagar & M N Avadhanulu, S Chand & Company Ltd
2. **"**Solid State Physics" by SO Pilai., - New age International Publishers
3. "Engineeing Physics by P.K.Palanisamy, Scitech publications (New Edition 2019)

REFERENCE BOOKS

1. "Sensor and Transducers" by Ian R Sinclair, Elsevier (Newnes) 3rd Eds
2. Kettles Introduction to Solid state Physics-Charles Kittel,Wiley India Edition
3. "Engineering Physics" by M.R.Srinivasan, New Age international publishers

WEB RESOURCES

1. https://nptel.ac.in/courses/113/104/113104014/
2. https://nptel.ac.in/courses/113106032/15%20-%20Magnetic%20Properties.pdf
3. https://nptel.ac.in/courses/113/104/113104090/
4. https://www.svce.ac.in/departments/physics/downloads/Notes/UnitIV/UNIT%20IV%20Acoustics.pdf
5. https://nptel.ac.in/courses/124/105/124105004/
6. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cy13/
7. http://engineering.nyu.edu/gk12/amps-cbri/pdf/Intro%20to%20Sensors.pdf
8. https://nccr.iitm.ac.in/2011.pdf
9. https://nptel.ac.in/courses/118/104/118104008/

I Year I Semester
Programming for Problem solving using C
(Common to CE, ME, EEE, ECE, CSE, CSE (AI&ML), CSE(DS), IT)

Course Category	Engineering Science	**Course Code**	20CS1T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2	To gain knowledge of the operators, selection, control statements and repetition in C
3	To learn about the design concepts of arrays, strings, enumerated structure and union types and their usage.
4	To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
5	To assimilate about File I/O and significance of functions

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply the fundamentals of C Programming for Problem solving.	K3
CO2	Identify the appropriate Decision statement and Loops for a given Problem.	K2
CO3	Make use of Arrays and Strings to solve the problems in C.	K3
CO4	design and implement programs to analyze the different pointer applications	K3
CO5	Develop solutions for problems using Files and Functions.	K3

Note: K1- Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	0	0	0	0	0	0	0	1	1	0
CO2	3	3	3	3	1	0	0	0	0	0	0	0	1	1	0
CO3	3	3	3	2	1	0	0	0	0	0	0	0	2	1	0
CO4	2	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO5	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0

COURSE CONTENT

UNIT I

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

UNIT II

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions.

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples.

UNIT III

Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages

Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application.

UNIT IV

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value

Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application.

Processor Commands: Processor Commands.

UNIT V

Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion

Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions

Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

TEXT BOOKS	
1.	Programming for Problem Solving, Beerhouse A. Forouzan, Richard F.Gilberg, CENGAGE.
2.	The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson.
REFERENCE BOOKS	
1.	Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill.
2.	Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson.
3.	Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/106104128/

2.	http://students.iitk.ac.in/programmingclub/course/#notes
3.	http://c-faq.com/~scs/cclass/cclass.html
4.	http://www.youtube.com/watch?v=b00HsZvg-V0&feature=relmfu
5.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/

I Year I Semester

ENGINEERING DRAWING

(Common for EEE, ECE & ME)

Course Category	Engineering Science	**Course Code**	20ME1T02
Course Type	Theory	**L-T-P-C**	1-0-4-3
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To introduce the students to use drawing instruments and to draw polygons, Engineering Curves and Scales.
2	To introduce the students to use orthographic projections, projections of points and lines.
3	To make the students draw the projections of the planes.
4	To make the students draw the projections of the various types of solids.
5	To represent the object in 3D view through isometric views.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Construct polygons, scales and engineering curves.	K3
CO2	Identify the position of points and lines with use of orthographic projections.	K3
CO3	Analyze the location and position of plane figures through orthographic projections.	K4
CO4	Analyze the location and position of solid bodies through orthographic projections.	K4
CO5	Develop 2D and 3D objects by converting their views.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	-	-	1	-	1	-
CO2	3	2	1	2	1	-	-	-	-	-	1	-	1	-
CO3	3	2	1	2	1	-	-	-	-	-	1	-	1	-
CO4	3	2	1	2	1	-	-	-	-	-	1	-	1	-
CO5	3	2	1	3	3	-	-	-	-	-	1	-	1	-

COURSE CONTENT

UNIT I

Introduction to Engineering Drawing.

Polygons: Constructing regular polygons by general method.

Curves: Parabola, Ellipse and Hyperbola by general methods tangent & normal for the curves. Cycloid and Involutes.

Scales: Vernier and Diagonal scales.

UNIT II

Orthographic Projections: Introduction, importance of reference lines, projections of points in various quadrants. Projections of straight lines inclined to both the planes, determination of true lengths and angle

of inclination.

UNIT III

Projections of planes: Regular planes perpendicular/parallel to one plane. Regular planes inclined to one plane and parallel to other, inclined to both the planes.

UNIT IV

Projections of Solids: Simple positions of Prisms, Pyramids, Cones and Cylinders. Solids inclined to both the planes.

UNIT V

Isometric Projections: Introduction, Conversion of isometric views to orthographic views, Conversion of orthographic views to isometric views. Introduction to AutoCAD (Demo only)

TEXT BOOKS

1. Engineering Drawing by N.D. Bhatt, Chariot Publications, 56th Edition.
2. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age International (P) Limited (2008).

REFERENCE BOOKS

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers, 3rd Edition.
2. Engineering Graphics for Degree by K.C. John, PHI Publishers.
3. Engineering Graphics by PI Varghese, Mc Graw Hill Publishers, 2013.
4. Engineering Drawing by Basant Agarwal, Tata McGraw Hill Publishers, 2014.
5. B.V.R. Gupta & M. Raja Roy, Engineering Drawing, I.K. International Publishing House Pvt. Ltd., 2009

WEB RESOURCES

1. http://nptel.ac.in/courses/112103019/
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_health_science_stu dents/engineeringdrawing.pdf

I Year I Semester

ENGINEERING PHYSICS LABORATORY

(Common to CE & ME)

Course Category	BASIC SCIENCES	**Course Code**	20BP1L01
Course Type	Lab	**L-T-P-C**	0 -0-3-1.5
Prerequisites	Intermediate Physics	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	The student will have exposure to various experimental skills which is essential for an Engineering student.
2	To gain practical knowledge by applying the experimental methods to correlate with the Theoretical Physics.
3	Apply the Analytical techniques and graphical analysis to the experimental data

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the basics of Mechanics, Elasticity, Diffraction using instruments like Fly wheel, Stewart Gee's, Grating	K2
CO2	Understand the basics of Waves and Oscillations in Physics using instruments like Volume Resonator, Sonometer.	K3
CO3	Determine the Magnetic and Dielectric constants of materials	K3

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT: (Any 10 of the following listed 15experiments) **8 experiments in Regular mode and any two experiments in Virtual Mode(Virtual Lab)**	
1.	Determination of Rigidity modulus of a material- Torsional Pendulum.
2.	Determination of Young's modulus by method of single cantilever oscillations.
3.	Determination of Acceleration due to Gravity and Radius of Gyration - Compound Pendulum.
4.	Verification of laws of transverse vibrations in a stretched strings – Sonometer.
5.	Determination of ultrasonic velocity in liquid (Acoustic grating)
6.	Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus

7.	Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
8.	Determination of dielectric constant by charging and discharging method
9.	Newton's rings – Determination of Radius of Curvature of Plano - Convex Lens.
10.	Determination of wavelength of Laser by diffraction grating
11.	Determination of particle size using Laser.
12.	Determination of Moment of Inertia of a Fly Wheel.
13.	Determination of Velocity of sound –Volume Resonator.
14.	Determination of Numerical Aperture and acceptance angle of an Optical Fiber
15.	Determination of wavelength of a light using Diffraction Grating-Normal incidence.

TEXT BOOKS	
1.	College customized manual
WEB RESOURCES	
1.	www.vlab.co.in (virtual lab link)

I Year I Semester
Professional Communicative English Lab
(Common to CE, EEE, MECH, ECE, CSE, CSE (DS), CSE (AI&ML), & IT)

Course Category	Basic Sciences	**Course Code**	20HE1L01
Course Type	Theory	**L-T-P-C**	0-0-3-1.5
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

CO	Description	COGNITIVE LEVEL
CO1	Understand different speech sounds and maintain proper pronunciation and rhythm in day to day conversations.	K2
CO2	Interpret and respond appropriately in various day to day contexts and improves technics in group discussions.	K5
CO3	Develop the required communication skills to deliver effective presentations and interviews with clarity and impact.	K6

K1- Remembering, K2- Understanding, K3-Applying, K-4 Analyzing, K5- Evaluating, K6- Creating

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-

PRESCRIBED LAB MANUAL FOR SEMESTER I:

'**STRENGTHEN YOUR STEPS**: A Multimodal Course in Communication Skills' Published by Maruthi Publications.

OBJECTIVES: To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.

OUTCOME: A study of the communicative items in the laboratory will help the students become successful in the competitive world.

The course content, along with the study material, is divided into six units.

UNIT 1:
Introduction
Consonant Sounds
Vowel Sounds

UNIT 2:
Rhythm and Pronunciation
Weak/strong and contrasted forms
Practice of Rhythm

UNIT 3:
Dialogues

UNIT 4:
Group Discussions

UNIT 5:
Presentations & Public Speaking

UNIT-6: Interviews

I Year I Semester
Programming for Problem solving using C Lab
(Common to CE, ME, EEE, ECE, CSE, CSE (AI&ML), CSE(DS), IT)

Course Category	Engineering Science	**Course Code**	20CS1L01
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	Apply the principles of C language in problem solving.
2	To design flowcharts, algorithms and knowing how to debug programs.
3	To design & develop of C programs using arrays, strings pointers & functions.
4	To review the file operations, preprocessor commands.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Knowledge on various concepts of a C language.	K3
CO2	Draw flowcharts and write algorithms.	K3
CO3	Design and development of C problem solving skills.	K3
CO4	Design and develop modular programming skills.	K3

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO2	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO3	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0

COURSE CONTENT	
1.	**Exercise 1:** 1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters. 2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches. 3. Write a C program to display multiple variables.
2.	**Exercise 2:** 1. Write a C program to calculate the distance between the two points. 2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values",

	otherwise print "Wrong values".
3.	**Exercise 3:** 1. Write a C program to convert a string to a long integer. 2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape. 3. Write a C program to calculate the factorial of a given number.
4.	**Exercise 4:** 1. Write a program in C to display the n terms of even natural number and their sum. 2. Write a program in C to display the n terms of harmonic series and their sum. 1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms. 3. Write a C program to check whether a given number is an Armstrong number or not.
5.	**Exercise 5:** 1. Write a program in C to print all unique elements in an array. 2. Write a program in C to separate odd and even integers in separate arrays. 3. Write a program in C to sort elements of array in ascending order.
6.	**Exercise 6:** 1. Write a program in C for multiplication of two square Matrices. 2. Write a program in C to find transpose of a given matrix.
7.	**Exercise 7:** 1. Write a program in C to search an element in a row wise and column wise sorted matrix. 2. Write a program in C to print individual characters of string in reverse order.
8.	**Exercise 8:** 1. Write a program in C to compare two strings without using string library functions. 2. Write a program in C to copy one string to another string.
9.	**Exercise 9:** 1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation 2. Write a program in C to demonstrate how to handle the pointers in the program.
10.	**Exercise 10:** 1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator. 2.Write a program in C to add two numbers using pointers
11.	**Exercise 11:** 1. Write a program in C to add numbers using call by reference. 2. Write a program in C to find the largest element using Dynamic Memory Allocation.
12.	**Exercise 12:** 1.Write a program in C to swap elements using call by reference. 2.Write a program in C to count the number of vowels and consonants in a string using a pointer.
13.	**Exercise 13:** 1.Write a program in C to show how a function returning pointer. 2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.
14.	**Exercise 14:** 1.Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs 2. Write a program in C to convert decimal number to binary number using the function.

15.	**Exercise 15:** 1. Write a program in C to check whether a number is a prime number or not using the function. 2. Write a program in C to get the largest element of an array using the function.
16.	**Exercise 16:** 1. Write a program in C to append multiple lines at the end of a text file. 2. Write a program in C to copy a file in another name. 3. Write a program in C to remove a file from the disk.

I Year I Semester
ENVIRONMENTAL SCIENCES
(Common to CE, ME, ECE, CSE, CSE(DS & AI), IT)

Course Category	Basic Sciences	**Course Code**	20BE1MC01
Course Type	Theory	**L-T-P-C**	3 – 0 – 0 – 0
Prerequisites	Basic Knowledge in Environment and protection.	**Internal Assessment**	100 marks

COURSE OBJECTIVE:	
1	To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Gain a higher level of personal involvement and interest in understanding and solving environmental problems.
CO2	Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities
CO3	Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 21st century
CO4	Recognize the interconnectedness of human dependence on the earth's ecosystems
CO5	Influence their society in proper utilization of goods and services.
CO6	Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	1	0	0	1	2	0	0	0	1	0	0	0
CO2	0	1	0	0	0	0	1	0	0	0	0	0	0	0
CO3	0	0	0	0	2	0	1	0	0	0	0	0	0	0
CO4	0	0	0	0	1	1	3	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	3	1	0	0	0	0	0	0

Course contents:

UNIT – I
Multidisciplinary nature of Environmental Studies
Definition, Scope and Importance-*International Efforts & Indian Environmentalists*
Natural Resources
Forest resources : deforestation – Mining, dams and other effects on forest and tribal people.
Water resources :Use and over utilization of surface and groundwater.
Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems.
Energy resources: renewable and nonrenewable energy sources.
Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

LEARNING OUTCOMES:
Students will be able to
Articulate the basic structure, functions, and processes of key social systems affecting the environment
Explain why renewable and non-renewable energy resources are important.
Explain how water resources should be used.

UNIT- II
Ecosystems, Biodiversity and its conservation
Definition of Ecosystem and its structure, Functions
Biodiversity Definition-Value of biodiversity, India as a mega-diversity nation, Threats to biodiversity, Conservation of biodiversity, *Endangered and endemic species of India*.

LEARNING OUTCOMES:
Students will be able to
Get a clear picture of structure and functions of ecosystems.
Demonstrate knowledge and understanding of theories in the field of Biodiversity and Systematic in the broad sense.
Explain endangered and endemic species of India.

UNIT III
Environmental Pollution and Solid Waste Management
Definition, Cause, Effects of Air pollution, Water pollution, Noise pollution, Radioactive pollution, Role of an individual in prevention of pollution.
Solid Waste Management: Sources, effects and control measures of urban and industrial waste, *e-waste management*

LEARNING OUTCOMES
Students will be able to
Understand Cause, effects and control measures of air pollution.
Understand solid waste management.

UNIT IV
Social Issues and the Environment
Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act-Issues involved in enforcement of environmental legislation, Rain water harvesting, Global Environmental challenges-*case studies*

LEARNING OUTCOMES:
Students will be able to
Explain the enforcement of Environmental legislations
Acquire knowledge on various environmental challenges induced due to unplanned anthropogenic activities.
Explain the reasons for global warming

UNIT-V
Human population and the Environment
Population growth, Women and child welfare, Role of Information technology in environment and human health. *Impact Assessment and its significances, stages of EIA*
Field work:
A mini project related to Environmental issues / to visit a local polluted site (Submission of project by every student)
LEARNING OUTCOMES

Students will have

Explain various types of information technologies

Explain the theories of population explosion

Acquire knowledge on various environmental challenges induced due to unplanned anthropogenic activities

TEXT BOOKS	
1.	Environmental Studies for undergraduate courses by ErachBharucha,UGC.
2.	A Textbook of Environmental Studies by Dr.S.AzeemUnnisa,Acadamic publishing company.
3.	Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai
REFERENCE BOOKS	
1.	Text Book of Environmental Studies by Deeshita Dave & P. UdayaBhaskar, Cengage learning.
2.	Glimpses of Environment by K.V.S.G. Murali Krishna Published by Environmental Protection Society, Kakinada, A.P.
3.	Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi
4.	Environmental Studies by PiyushMalaviya, Pratibha Singh, Anoopsingh: Acme Learning, New Delhi.
5.	An Introduction to Environmental Pollution by Dr.B.k.Sharma AND Dr.(Miss)H.kaur,Goel publishing House ,a unit of Krishna Prakasham Media (p) LH,Meerut –India
WEB RESOURCES	
1.	**UNIT-1: MULTI DISPLINARY NATURE OF ENVIRONMENT and NATURAL RESOURCES** http://www.defra.gov.uk/environment/climatechange https://www.climatesolutions.org https://en.wikibooks.org/wiki/Ecology/Ecosystems
2.	**UNIT-2:ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION** http://conbio.net/vl/ and www.biodiversitya-z.org/content/biodiversity
3.	**UNIT-3: ENVIRONMENTAL POLLUTION** https://www.omicsonline.org/environment-pollution-climate-change.php and https://www.britannica.com/technology/solid-waste-management
4.	**UNIT-4: SOCIAL ISSUES AND THE ENVIRONMENT** http://www.publichealthnotes.com/solid-waste-management/
5.	**UNIT-5: HUMANPOPULATION AND THE NVIRONMENT**http://www.ecoindia.com/education/water-conservation.html https://thewaterproject.org/water_conservation\ https://legalcareerpath.com/what-is-environmental-law/

I B. Tech II Semester
Linear Algebra and Partial Differential Equations
(Common to CE, ME, ECE, CSE, IT, CSE-DS, CSE-AI&ML)

Course Category	Basic Sciences	**Course Code**	20BM2T02
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Basics of Matrices, Differentiation, Integration	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	solve systems of linear equations, determine the rank, find the eigenvalues and eigenvectors, diagonalization of a matrix.	K3
CO2	identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics.	K2
CO3	find areas and volumes using double and triple integrals	K2
CO4	find partial derivatives of multivariable functions and apply them to find extreme values of a function.	K3
CO5	apply a range of techniques to find solutions of standard PDEs	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	-		
CO2	3	3	2	-	-	-	-	-	-	-	-	-		
CO3	3	3	2	-	-	-	-	-	-	-	-	-		
CO4	3	3	2	-	-	-	-	-	-	-	-	-		
CO5	3	3	2	-	-	-	-	-	-	-	-	-		

COURSE CONTENT	
UNIT I	**Solving system of linear equations, Eigen Values and Eigen vectors** Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss elimination method, Gauss Jacobi and Gauss Seidel for solving system of equations – Eigenvalues and Eigen vectors and their properties.
UNITII	**Cayley-Hamilton Theorem and Quadratic forms** Cayley-Hamilton theorem (without proof) – Finding inverse and powers of a matrix by Cayley-Hamilton theorem – Quadratic forms-Reduction to canonical form by congruent transformations- nature of the quadratic form - reduction of quadratic form to canonical form by orthogonal transformation.
UNITIII	**Multiple integrals** Multiple integrals: Double and triple integrals – Change of variables -Polar coordinates - Cylindrical coordinates– Change of order of integration. **Applications:** Finding Areas and Volumes.
UNITIV	**Partial differentiation** Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Generalized Mean value theorem for single variable (without proof) – Taylor's and Maclaurin's series expansion of functions of two variables – Jacobian – Functional dependence. **Applications:** Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).
UNITV	**Partial Differential Equations and Applications** Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations. **Applications:** One dimensional wave and heat equations.

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India
REFERENCE BOOKS	
1.	**Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn
2.	**Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
3.	**Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
4.	**Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**T.K.V. Iyengar et. al.,** Engineering Mathematics Volume I & III S Chand Publications.
6.	**T. Amarnath,** An Elementary Course in Partial Differential Equations, Narosa Publications
WEB RESOURCES	
1.	**UNIT I: Solving system of linear equations, Eigen Values and Eigen vectors** https://en.wikipedia.org/wiki/System_of_linear_equations https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
2.	**UNIT II: Cayley-Hamilton Theorem and Quadratic forms** https://www.math.hmc.edu/calculus/tutorials/eigenstuff/

	https://en.wikipedia.org/wiki/Quadratic_form
3.	**UNIT III: Multiple Integrals** https://en.wikipedia.org/wiki/Multiple_integral http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx
4.	**UNIT V: Partial Differentiation** https://en.wikipedia.org/wiki/Partial_derivative https://www.whitman.edu/mathematics/calculus_online/section14.03.html
5.	**UNIT V:Partial Differential Equations and Applications** https://en.wikipedia.org/wiki/Partial_differential_equation

I Year II Semester
Engineering Chemistry
(Common to CE, ME)

Course Category	Basic Sciences	**Course Code**	20BC2T01
Course Type	Theory	**L-T-P-C**	3 – 0 – 0 – 3
Prerequisites	Intermediate Chemistry	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn about the hardness of water, boiler troubles, Drinking water standards and methods of removal of hardness of water.
2	To get knowledge on Electrochemical cells, Batteries, fuel cells and fuels and their applications.
3	To study about the factors affecting corrosion and their controlling methods.
4	To learn about Cement, its setting and hardening and about Polymers, Plastics and Elastomers.
5	To study about Nano materials, their preparation, and applications and to create awareness on surface chemistry.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Compare the quality of drinking water with BIS and WHO Standards	K2
CO2	Illustrate the principles and applications of Batteries, Fuel cells and fuels.	K3
CO3	Identify different types of corrosion and their controlling methods.	K3
CO4	Illustrate the principles of setting and hardening of cement and explain about polymers and their engineering applications.	K2
CO5	Analyze the importance of nano materials and surface chemistry.	K4

Contribution of Course Outcomes towards achievement of Program : Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	1	2	-	3	3	-	-	-	2	1	1	-	1
CO2	2	1	-	-	2	-	1	-	-	-	2	2	-	-	-
CO3	1	-	2	-	2	-	1	-	-	-	1	-	-	1	-
CO4	3	-	1	2	-	1	1	-	-	-	2	-	1	-	-
CO5	2	-	3	-	-	2	2	-	-	-	1	1	-	-	-

COURSE CONTENT	**ENGINEERING CHEMISTRY SYLLABUS**
UNIT I	**WATER TECHNOLOGY** **8 hrs** Introduction –Hard and Soft water, Estimation of Hardness by EDTA Method - Boiler troubles - Scale and Sludge- Specifications for Drinking water, Bureau of Indian Standards (BIS) and World Health Organization (WHO) standards, Zeolite and Ion-Exchange processes- Desalination of Brackish water, Reverse Osmosis (RO) and Electro Dialysis. **Learning Outcomes:** The student will be able to List the differences between temporary and permanent hardness of water (L1) Explain the Principles of Reverse Osmosis and Electro dialysis. (L2) Compare quality of Drinking water with BIS and WHO standards. (L2)

	Illustrate Disadvantages associated with hard water. (L2)
UNIT II	**ENERGY SOURCES AND APPLICATIONS 10hrs** **Electrodes:** Electrode potential, Determination of Single Electrode Potential –Nernst's equation, Reference electrodes: Hydrogen and Calomel electrodes **Batteries:** Primary cell- Dry or Leclanche cell, Secondary cell- Lithium batteries (Lithium-MnO_2); **Fuel cells:** H_2-O_2 fuel cell, Methanol fuel cell **Fuels**- Types of fuels, Calorific value, Numerical problems based on Calorific value; Analysis of Coal, Liquid fuels : Refining of Petroleum, Cracking: Catalytic cracking- Fixed bed and Moving bed methods, Knocking and Anti knocking agents, Octane and Cetane Values. **Biofuels** – Bio Diesel, Power Alcohol. **Learning Outcomes:** At the end of this unit, the students will be able to Apply Nernst equation for calculating electrode and cell potentials (L3) Compare different batteries and their applications (L2) Explain calorific values, octane number, refining of petroleum and cracking of oils (L2)
UNIT III	**CORROSION AND ITS CONTROLLING METHODS 6+6 hrs** **III-A: Corrosion:** Definition – Theories of Corrosion-Dry corrosion: Metal oxide formation - Pilling Bed Worth ratio; Electro Chemical Corrosion: Mechanism, Factors affecting the Corrosion rate (pH, temperature, DO). **III-B: Corrosion Controlling Methods:** Sacrificial and Impressed Current Cathodic Protection. Metallic Coatings – Galvanizing and Tinning- Electro Plating and Electroless Plating. **Learning Outcomes:** At the end of this unit, the students will be able to Apply Pilling Bedworth rule for Corrosion and Corrosion Prevention (L3) Demonstrate the corrosion prevention methods and factors affecting corrosion (L2)
UNIT IV	**POLYMER CHEMISTRY AND CEMENT 10 hrs** **Polymers**: Introduction- Functionality of Monomers, Chain (Addition) Polymerization, Step (Condensation) Polymerization, Co-Ordination Polymerization, Co Polymerization with examples and Mechanism. Conducting Polymers – Mechanism of Conduction in Poly acetylene, Poly aniline and their Applications, **Plastics**: Thermoplastics and Thermo Setting Resins; Preparation, Properties and Applications of Polystyrene and Bakelite. **Elastomers**: Preparation, Properties and applications of Buna-S and Thiokol. **Cement:** Portland Cement, Constituents, Manufacture of Portland Cement, Chemistry of Setting and Hardening of Cement. **Learning Outcomes:** At the end of this unit, the students will be able to Explain different types of polymers and their applications (L2) Demonstrate the mechanism of conduction in conducting polymers (L2) Identify the constituents of Portland cement and explanation of the manufacturing of cement(L2) Enumerate the reactions at different temperatures in the Manufacture of Cement (L2)
UNIT V	**NANOMATERIALS AND SURFACE CHEMISTRY 8 hrs** **Nanomaterials:** Introduction, Preparation of Carbon Nano Tubes (CNTs) by Arc discharge and Chemical Vapor Deposition Methods. Fullerenes -Preparation, Properties and Applications. Chemical synthesis of Nanomaterials: Sol-gel method, Applications of Nanomaterials in Wastewater treatment, Medicine and ***in Lubricants*.** **Surface Chemistry:** Introduction to Surface Chemistry, Colloids, Nanometals and

	Nanometal Oxides, Functionalization of Surface of Nanomaterials, Applications of Colloids and Nanomaterials in Catalysis and Sensors. **Learning Outcomes:** At the end of this unit, the students will be able to Classify Nanomaterials. (L-2) Explain the Synthesis and applications of Nanomaterials. (L-2) Identify the application of Colloids and Nanomaterials in Medicine, Sensors and Catalysis (L2)
TEXT BOOKS	
1	P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2	Engineering Chemistry by Shikha Agarwal: Cambridge University Press,2019 edition .
REFERENCE BOOKS	
1	Sashi Chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2	S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, (2010)
3	N. Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014)
WEB RESOURCES	
1	**Water Technology**
	1.https://www.scribd.com/document/.../Engineering-Chemistry-Unit-I-Water-Treatment 2.www.lenntech.com/applications/process/boiler/boiler-water-treatment.htm
2	**Energy Sources and Applications**
	https://en.wikipedia.org/wiki/Electrochemical_cell
3	**Corrosion and its controlling methods**
	https://en.wikipedia.org/wiki/Corrosion
4	**Polymer Chemistry and Cement**
	https://en.wikipedia.org/wiki/Polymer_chemistry
5	**Nano Materials and surface Chemistry**
	https://en.wikipedia.org/wiki/Nanomaterials

I Year II Semester
ENGINEERING MECHANICS
(Mechanical Engineering)

Course Category	Engineering Science	**Course Code**	20ME2T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Physics and Applied Mathematics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To study forces, free body diagrams & equations of equilibrium of coplanar systems and its applications.
2	To study Trusses, friction and its applications.
3	To learn about centroid and moments of Inertia of simple and composite figures.
4	To learn various paths of velocity and acceleration computation.
5	To study about work, energy and particle motion for engineering applications.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze the Forces, Free Body Diagrams & Equations of Equilibrium of Coplanar Systems.	K4
CO2	Analyze the trusses, friction and its applications.	K4
CO3	Evaluate the centroid and moments of Inertia of Composite Figures.	K5
CO4	Determine the paths of velocity and acceleration computation.	K5
CO5	Adapt the concepts of work, energy and particle motion for engineering applications.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1	-	-	-	-	-	-	-	-	-	2
CO2	3	3	3	2	-	1	-	-	-	-	-	-	-	2
CO3	3	3	3	2	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	3
CO5	2	1	1	2	-	-	-	-	-	-	-	-	-	2

COURSE CONTENT

UNIT I

Introduction to Engineering Mechanics: Basic Concepts of mechanics, System of Forces.

Resultant System of Forces: Resultant of Coplanar Concurrent Force System - Moment of a Force, Couple, Varignon's Theorem, Resultant of Coplanar Non-Concurrent Force System.

Equilibrium System of Forces: Equations of Equilibrium of Coplanar Systems, Free Body Diagrams, Lami's Theorem, Equilibrium of Connected Bodies.

UNIT II

Friction: Introduction**,** types of friction, Coulomb‟s laws of dry friction, coefficient of friction, cone

of friction.
Trusses: Introduction, Assumptions and Equilibrium analysis of plane trusses by using method of joints.

UNIT III
Centroid: Introduction**,** Centroids of simple and composite sections.
Centre of Gravity: Simple bodies and Composite bodies, Pappus Theorem.
Moment of Inertia: Definition – Transfer Theorem, Perpendicular Theorem, Polar Moment of Inertia, Moment of Inertia of Simple and Composite Figures, mass moment of inertia of simple bodies.

UNIT IV
Kinematics: D'Alembert"s Principle, Rectilinear Motion and curvilinear motion, Motion with Uniform Velocity, Motion with Uniform Acceleration.
Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation, Equations of Plane Motion– Fixed Axis Rotation.

UNIT V
Work – Energy Method: Equations for Translation, Motion of Connected Bodies Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS

1. Engineering Mechanics - S.Timoshenko, D.H.Young., 5th Edition - , Mc Graw Hill.
2. Engineering Mechanics - S. S. Bhavikatti, K G Rajasekharappa, Revised Edition, New Age International.

REFERENCE BOOKS

1. Engineering Mechanics, N.H.Dubey, McGraw Hill, 2013.
2. Engineering Mechanics, A.K.Tayal, 14th edition, 2nd reprint, Umesh Publications, 2012
3. Engineering Mechanics, R.K.Bansal, 3rd edition, Laxmi Publications, 1996.
4. Engineering Mechanics: Statics & Dynamics, A. Nelson, Tata McGraw-Hill Education, 2009.
5. Engineering Mechanics, Fedinand . L. Singer, Harper – Collins.

WEB RESOURCES
1. http://nptel.ac.in/courses/Webcourse-contents/IITKANPUR/engg_mechanics/ui/Course_home_3.htm
2. http://nptel.ac.in/courses/122104015/
3. https://nptel.ac.in/courses/122104015/
4. https://freevideolectures.com/course/2264/engineering-mechanics
5. https://nptel.ac.in/courses/112103108/3
6. https://nptel.ac.in/courses/115104094/54

I Year II Semester

Basic Electrical and Electronics Engineering

(Only for ME)

Course Category	Engineering Sciences	**Course Code**	20EE2T01
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NA**	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To learn the basic principles of electrical circuit analysis.
2	To understand constructional details and operating principle of DC machines & Transformers.
3	To understand constructional details and operating principle details of alternator and 3-Phase induction motor
4	To study operation of PN junction diode, half wave, full wave rectifiers, PNP and NPN transistors and various semiconductor devices.
5	To study the operation of OP-AMPs.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze various electrical circuits	K4
CO2	Understand constructional details and operating principle of DC machines, single phase transformer, tests and analyze their performance.	K4
CO3	Explain operation of Three phase AC machines.	K2
CO4	Analyze operation of half wave, full wave bridge rectifiers and Explain single stage CE amplifier and concept of various semiconductor devices.	K4
CO5	Analyze operation of OP-AMPs.	K4

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	3	2	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT 1	**Electrical Circuits** Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – star-delta and delta-star transformations
UNIT 2	**DC Machines** Constructional details and operating principle – EMF equation –DC motor – torque equation – applications - speed control methods of DC motor – Swinburne's Test.

UNIT 3	**Transformers** Constructional details and operating principle of single phase transformers – EMF equation – equivalent circuit – Losses – OC & SC tests – efficiency. **3 Phase Induction Motors** Principle of operation of 3-Phase squirrel cage induction motor – electromagnetic torque equation - power flow - brake test - efficiency calculation – applications.
UNIT 4	**Alternators** Constructional details and operating principle of alternators – types –Regulation of alternator by synchronous impedance method.
UNIT 5	**Semiconductor Devices** PN junction diodes – characteristics – half wave and full wave rectifiers - PNP and NPN junction transistor, transistor as an amplifier – transistor amplifier – frequency response of CE amplifier – concepts of feedback amplifier – SCR – MOSFET - IGBT. **Operational Amplifiers** Introduction to operation amplifiers (Ideal OP-AMP) – Characteristics – applications (inverting, non- inverting, integrator and differentiator).

TEXT BOOKS	
1	William Hayt and Jack E. Kemmerley, Engineering Circuit Analysis, Mc Graw Hill Company, 6th Edition.
2	Surinder Pal Bali, Electrical Technology, Vol-I, Vol-II, Pearson Publications, 1st Editiom.
3	Basic Electrical and Electronics Engineering by M.S. Sukhija and T.K. Naga Sarkar, Oxford University Press.
4	R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, PEI/PHI 2006, 9th Edition.
REFERENCE BOOKS	
1	John Bird, Electrical Circuit Theory and Technology, Routledge Taylor and Francis Group, 5 th Edition.
2	M.S.Naidu and S.Kamakshiah, Basic Electrical Engineering, TMH Publications, 1 st Edition
3	Rajendra Prasad, Fundamentals of Electrical Engineering, PHI Publications, 2nd edition.
4	R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand & Co. 2 nd Edition
5	David A. Bell, Electronic Devices and Circuits, Oxford University Press, 5 th Edition.
WEB RESOURCES (Suggested)	
1	www.nptel.ac.in/courses/108108076/
2	https://nptel.ac.in/courses/122106025/

I Year II Semester

COMPUTER AIDED ENGINEERING DRAWING

(Mechanical Engineering)

Course Category	Professional Core	**Course Code**	20ME2L03
Course Type	Theory and Laboratory	**L-T-P-C**	2-0-2-3
Prerequisites	Engineering Drawing	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To enhance the skills in drawing of projections of solids.
2	To impart the knowledge of sectioning and development of surfaces of solids.
3	To learn the Interpenetration of solids and also methods of Perspective views.
4	To introduce various commands in AutoCAD and to create 2D wire frame models.
5	To create 3D wire frame models and geometrical model of simple solids and machine parts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level***
CO1	Draw the auxiliary projections of the various types of solids.	K3
CO2	Develop the sections of solids.	K3
CO3	Create perspective views of a given 3D object/part.	K3
CO4	Understand the AutoCAD commands.	K2
CO5	Create 3D views using AutoCAD.	K3

*K1- Remembering, K2- Understanding, K3- Applying, K4- Analyzing, K5- Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	-	-	-	1	2	-	3	-	3
CO2	3	2	2	-	-	-	-	-	1	2	-	3	-	3
CO3	3	2	2	-	-	-	-	-	1	2	-	3	-	3
CO4	3	2	2	-	3	-	-	-	1	2	-	3	-	3
CO5	3	2	2	-	3	-	-	-	1	2	-	3	-	3

COURSE CONTENT

UNIT I

Projections of Solids: Projections of Regular Solids - Auxiliary Views.

UNIT II

Sections of Solids: Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

Development of Solids: Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, Cone and their parts.

UNIT III

Interpenetration of Right Regular Solids: **Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone.**

Perspective Projections: Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods (General Method only).

UNIT IV

Introduction to Computer Aided Drafting: Generation of points, lines, curves, polygons, dimensioning. Types of modeling: object selection commands – edit, zoom, hatching, layers, pattern filling, utility commands, 2D wire frame modeling and other commands like view points and view ports, examples to exercise different options like save, restore, delete, joint, single option.

UNIT V

Computer Aided Solid Modeling: Isometric projections, orthographic projections of isometric projections, perspective views, modeling of simple solids, 3D wire frame modeling, Boolean operations.

TEXT BOOKS

1. Engineering Graphics, K.C. john, PHI Publications, 2009
2. Engineering Drawing by N.D Bhatt , Charotar Publications,53rd Edition.

REFERENCE BOOKS

1. Engineering Graphics using AutoCad ,T Jeyapoovan, Vikas Publications, 7th Edition.
2. Engineering Drawing and Graphics + Auto CAD ,K Venugopal, New age international publications, 4th Edition.
3. Engineering Drawing, RK Dhawan, S.Chand Publications, Revised Edition.
4. Engineering Drawing ,KL Narayana,Scitech Publications, 2013
5. Engineering Drawing – Basant Agarwal and C.M. Agarwal, Mc Graw Hill Education, 2nd Edition.

WEB RESOURCES

1. http://nptel.ac.in/courses/112103019/
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_health_science_stu dents/engineeringdrawing.pdf

I Year II Semester
ENGINEERING WORKSHOP
(For ME and CE)

Course Category	Engineering Science	**Course Code**	20ME2L01
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To familiarize with the basic material removal/shaping processes.
2	To study the various tools and equipment used in different hands on sessions.
3	To develop a skill in dignity of labor, precision, safety at work place.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Practice on manufacturing of components using workshop trades including fitting and carpentry.	K3
CO2	Design different types of models by using workshop trades including black smithy and tin smithy.	K4
CO3	Apply basic electrical engineering knowledge for house wiring practice.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO3	3	-	3	-	3	-	-	-	-	-	-	-	3	3

LIST OF EXPERIMENTS

A. Carpentry:
1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

B. Fitting:
1. V Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

C. Black Smithy:
1. Round rod to Square
2. S-Hook
3. U- Hook
4. Round Rod to Flat Ring

D. House Wiring:

1. Parallel Connection of three bulbs
2. Series Connection of three bulbs
3. Stair Case wiring
4. Florescent Lamp Fitting

E. Tin Smithy:

1. Square Box without lid
2. Open Scoop
3. Taper Tray
4. Funnel

Note: At least two exercises to be done from each trade.

I Year II Semester

ENGINEERING CHEMISTRY LAB

Course Category	Basic sciences	**Course Code**	20BC2L01
Course Type	Lab	**L-T-P-C**	0-0-3-1.5
Prerequisites	Basic Chemistry	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OUTCOMES		
Upon successful completion of this course, the student will be able to:		**Cognitive Level**
CO1	estimate the given amount of dissolved compounds in a solution by using volumetric analysis and preparation of polymers and nano particles	K3
CO2	determine the concentration of different metal ions present in water by compelxometric titrations.	K2
CO3	evaluate the accurate value of P^H and conductivity of given solutions and to estimate the viscosity and surface tension of given solutions.	K5

Contribution of Course Outcomes towards achievement of Program Outcomes (1–Low, 2-Medium,3–High)

	P01	**P02**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**P09**	**P010**	**P011**	**P012**	**PS01**	**PSO2**
CO1	2	1	2											
CO2	2	1		1										
CO3	2	1												

COURSE CONTENT

(Any 10 of the following listed 13 experiments)

LIST OF EXPERIMENTS:

Introduction to chemistry laboratory –Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis

1. Estimation of HCI using standard Na_2CO_3 solutions
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH
3. Estimation of $KMnO_4$ using standard Oxalic acid solution.
4. Estimation of Ferrous iron using standard $K_2Cr_2O_7$ solution
5. Determination of Temporary and permanent Hardness of water using standard EDTA solution.
6. Determination of pH of the given sample solution using pH meter
7. Determination of Fe (III) using Colorimetric method
8. *Estimation of HCl using standard NaOH by Conductometric titration.*
9. Estimation of Vitamin – C
10. Preparation of Phenol - Formaldehyde Resin
11. Determination of viscosity of a liquid
12. Determination of surface tension of a liquid
13. Preparation of Nano particles.(Cu/Zn)

TEXTBOOKS

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

REFERENCEBOOKS

[1] College designed manual

WEB-RESOURCES
www.bsauniv.ac.in/UploadImages/Downloads/Estimation%20of%20Hardness https://pubs.acs.org/doi/abs/10.1021/i560133a023

I Year II Semester

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

(Only for ME)

Course Category	Engineering Sciences	**Course Code**	20EE2L01
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	**15** **35** **50**

COURSE OBJECTIVES	
1	To determine the voltage, current and power in star and delta connected loads
2	To predetermine the efficiency of DC shunt machine using Swinburne's test
3	To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
4	To obtain performance characteristics of DC shunt generator & 3-phase induction motor.
5	To find out regulation of an alternator with synchronous impedance method.
6	To control speed of dc shunt motor using Armature voltage and Field flux control methods.
7	To find out the characteristics of PN junction diode & transistor
8	To determine the ripple factor of half wave & full wave rectifiers.
9	To find out the band width of transistor CE amplifier.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Determine the voltage, current and Power in Star and Delta Connected loads.	K3
CO2	Compute the efficiency of DC shunt machine without actual loading of the machine	K3
CO3	Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.	K5
CO4	Analyze the performance characteristics to determine critical speed and resistance of DC shunt generator & efficiency of 3-Phase induction motor.	K4
CO5	Pre-determine the regulation of an alternator by synchronous impedance method.	K4
CO6	Control the speed of DC shunt motor using Armature voltage and Field flux control methods.	K3
CO7	Draw the characteristics of PN junction diode & transistor	K2
CO8	Determine the ripple factor of half wave & full wave rectifiers	K3
CO9	Analyze the frequency response of to find the bandwidth of CE amplifier	K4

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	2	-	-	-	-

CO6	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO7	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO8	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO9	2	-	-	-	-	-	-	-	-	2	-	-	-	-

LIST OF EXPERIMENTS:	
Section A: Electrical Engineering(Any 6 of the following experiments are to be conducted)	
Experiment 1	Measurement of voltage, current and Power in Star and Delta Connected loads
Experiment 2	Magnetization characteristics of DC Shunt Generator
Experiment 3	Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
Experiment 4	Speed control of D.C. Shunt motor by a) Armature Voltage control b) Field control method.
Experiment 5	OC and SC tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
Experiment 6	Load Test on Single Phase Transformer
Experiment 7	Brake test on 3-phase Induction motor (determination of performance characteristics)
Experiment 8	Regulation of alternator by Synchronous impedance method.
Section B: Basic Electronics(Any 4 of the following experiments are to be conducted)	
Experiment 9	PN junction diode characteristics a) Forward bias b) Reverse bias
Experiment 10	Transistor CE characteristics (input and output)
Experiment 11	Half wave rectifier with and without filters.
Experiment 12	Full wave rectifier with and without filters.
Experiment 13	CE amplifiers.
Experiment 14	OP- amp applications (integrator and differentiator).

I Year II Semester
CONSTITUTION OF INDIA

Course Category	Humanities including Management	**Course Code**	20HE2T05
Course Type	Theory	**Lecture-Tutorial-Practice**	2 -0 -0-0
Prerequisites		**Total Marks (Internal Assessment)**	100

Course Outcomes		**Blooms Taxonomy Level**
On successful completion of the course, the student will be able to		
CO 1	Understand the evolution of Constitution of India	Understanding
CO 2	Make use of one's Fundamental rights.	Application
CO 3	Understand the functioning of the Union Government	Understanding
CO 4	Understand the functioning of the State and local self Government.	Understanding
CO 5	Understand the value of Indian Constitution in functioning of the country.	Understanding

Contribution of Course Outcomes towards achievement of Program												
Outcomes: 1 – Low, 2 - Medium, 3 – High												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	0	0	0	0	3	0	3	0	1	0	2
CO2	0	0	0	0	0	1	0	2	1	1	0	1
CO3	0	0	0	0	0	1	0	1	1	1	0	0
CO4	0	0	0	0	0	1	0	1	1	1	0	0
CO5	0	0	0	0	0	1	1	1	1	1	0	2

COURSE CONTENT:

UNIT – I

Introduction to Indian constitution: Meaning of the term constitution - History and development - Preamble of the Constitution – Constituent Assembly – The salient features of Indian Constitution.

UNIT –II

Fundamental Rights: Individual and Collective Rights – Limitations of the fundamental Rights - Fundamental Rights Vs Duties

UNIT –III

Union Government: Union Legislature – Lok Sabha and Rajya Sabha (powers and functions) - President of India (powers and functions) – Prime minister of India (powers and functions) –Union Judiciary (supreme court powers and functions).

UNIT – IV

State and Local self Government:

State Government: State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council/Vidhan Parishad) – Powers and functions of state legislature – The Chief Minister of the state (powers and functions)

Local Self Government: Election commission of India (Powers and Functions)- The Union Public Service Commission (Powers and Functions)

UNIT – V

Working of the Indian Constitution

The values of the Indian Constitution and Ushering of Social Revolution in India – Nature and Role of Higher Judiciary in India – Amendments (Recent)

REFERENCE BOOKS :

1. 'Indian Polity' byLaxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti

WEB RESOURCES:

1. https://www.clearias.com/historical-background-of-indian-constitution/
2. https://www.civilserviceindia.com/subject/General-Studies/notes/functions-and-responsibilities-of- the-union-and-the-states.html
3. https://www.tutorialspoint.com/indian_polity/indian_polity_how_constitution_works

II Year I Semester
TRANSFORMS AND VECTOR CALCULUS
(Common to CE, ME, ECE, CSE, IT, CSE-DS & CSE-AI&ML and CSE-AI branches)

Course Category	Basic Sciences	**Course Code**	20BM3T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	examine the properties of Laplace transformation	K3
CO2	solve ordinary differential equations by using Laplace transformation technique	K2
CO3	expand a periodic function as a Fourier series and find Fourier transform of a given function.	K3
CO4	understand vector differential properties of scalar and vector point functions and their applications.	K2
CO5	apply Green's, Stokes and Divergence theorem to evaluate line, surface and volume integrals.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Laplace transforms:** Laplace transforms of standard functions – Properties - Periodic functions - Unit step function – Dirac's delta function.

UNIT II	**Inverse Laplace transforms:** Inverse Laplace transforms – Properties – Convolution theorem (without proof). **Applications:** Solving ordinary differential equations (initial value problems) using Laplace transforms.
UNIT III	**Fourier Analysis:** Introduction- Periodic functions – Dirichlet's conditions - Fourier series of a function, even and odd functions –Change of interval – Half-range sine and cosine series. Fourier integral theorem (without proof) – Fourier sine and cosine integrals – sine and cosine transforms – Inverse transforms.
UNIT IV	**Vector Differentiation:** Gradient - Directional derivative - Divergence – Curl – Laplacian and second order operators – Vector identities.
UNIT V	**Vector Integration:** Line integral – Work done – Potential function – Area, Surface and volume integrals - Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and related problems.

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India
REFERENCE BOOKS	
1.	**Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn
2.	**Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
3.	**Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
4.	**Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**T.K.V. Iyengar et. al.,** Engineering Mathematics Volume I & III S Chand Publications.
6.	**Murray R Speigel,** Schaum's Outline of Vector Analysis, Schaum's Outline.
7.	**Shanti Narayan**, Integral Calculus – Vol. 1 & II
WEB RESOURCES	
1.	**UNIT I: Laplace transforms** https://en.wikipedia.org/wiki/Laplace_transform https://web.stanford.edu/~boyd/ee102/laplace.pdf
2.	**UNIT II: Inverse Laplace transforms** https://www.intmath.com/laplace-transformation/7-inverse-laplace-transform.php
3.	**Unit – III: Fourier Analysis** https://www.mathsisfun.com/calculus/fourier-series.html https://lpsa.swarthmore.edu/Fourier/Xforms/FXformIntro.html
4.	**UNIT IV: Vector Differentiation** https://en.wikipedia.org/wiki/Vector_calculus
5.	**UNIT V: Vector Integration** https://en.wikipedia.org/wiki/Divergence_theorem http://tutorial.math.lamar.edu/Classes/CalcIII/StokesTheorem.aspx

II Year I Semester
THERMODYNAMICS

Course Category	Professional Core	**Course Code**	20ME3T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Physics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand the basic concepts like thermodynamic system, its boundary and related fundamental definitions.
2	To learn the first law for different thermodynamic systems and apply steady flow energy equation for various mechanical components.
3	To understand the second law statements and the associated terms to apply the principles to heat engines.
4	Analyze the process of steam formation with various changes & mixture of perfect gases.
5	To understand various types of Thermodynamic cycles.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate basic concepts of thermodynamics and thermometry.	K2
CO2	Apply first law of thermodynamics for different thermodynamic systems.	K3
CO3	Analyze various concepts associated with second and third laws of thermodynamics.	K4
CO4	Analyze the mixture of perfect gases using property diagram with the use of steam tables and charts & analyze the mixture of perfect gases.	K4
CO5	Understand various types of Thermodynamic cycles	K2

K1: Remembering, K2: Understanding, K3: Applying, K4: Analysing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	-	1	1	-	-	-	-	-	2	-
CO2	2	2	2	2	-	1	1	-	-	-	-	-	2	-
CO3	2	2	2	2	-	-	-	-	-	-	1	1	2	-
CO4	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO5	2	2	2	2	-	-	-	1	-	-	-	2	2	-

COURSE CONTENT

UNIT I

Introduction: Basic Concepts: System, Boundary, Surrounding, Control Volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, reversibility and Irreversibility, Cycle –Quasi – static Process, Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas thermometer.

UNIT II

First law of Thermodynamics: Joule's Experiment – Corollaries – First law applied to a Process – applied to a flow system– PMM-I, Steady Flow Energy Equation. Throttling and free expansion processes –Ideal Gas Equations, deviations from perfect gas model – Vander Waals equation of state.

UNIT III

Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties. Thermodynamic scale of Temperature, concept of entropy, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations, Joule Thompson coefficient – Definition: Third Law of Thermodynamics.

UNIT IV

Pure Substances: P-V-T- surfaces, T-S and h-s diagrams, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction, Mixtures of perfect Gases ,Dalton's Law of partial pressure, Avogadro's Laws of additive volumes.

UNIT V

Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Brayton Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

TEXT BOOKS:

1. Thermodynamics: An Engineering Approach, Yunus A Cengel, Michael A Boles, McGraw-Hill, 9 th Edition
2. Engineering Thermodynamics by PK Nag, McGrawHill Publisher, 6th Edition.

REFERENCE BOOKS:

1. Thermodynamics, J.P.Holman, McGrawHill, 4th Edition 1988.
2. Fundamentals of Thermodynamics, G.J.Van Wylen & Richard E Sonntag, Claus Borgnakke, Wiley Publications, 6th Edition 2003.
3. An Introduction to Thermodynamics, Y.V.C.Rao – Universities press, 2004.
4. An Text Book of Engineering Thermodynamics, R K Rajput, Laxmi publications Ltd.,
5. Fundamentals of Engineering Thermodynamics, Volume 1, Michael - J.Moran, Howard N. Shapiro, Wiley Global Education, 7th Edition 2010.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/
3. http://www.nptelvideos.in/2012/12/basic-thermodynamics.html
4. https://freevideolectures.com/course/2681/basic-thermodynamics

II Year I Semester
METALLURGY AND MATERIAL SCIENCE

Course Category	Professional Core	**Course Code**	20ME3T05
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Chemistry	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To know the basic fundamentals of material science and understand the basic requirements for the formation of solid solutions and other compounds.
2	To study the basic construction of equilibrium diagram by studying various phases.
3	To study the differences between cast irons, steels, non-ferrous metals and alloys, their properties and practical applications.
4	To understand the various heat treatment and strengthening processes used in practical applications.
5	To study the concept of composite materials and its classification, nano materials.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the crystalline structure of different metals.	K2
CO2	Understand the various phases in equilibrium diagrams and draw phase diagrams of Cu-Ni, Bi-Cd and Fe-Fe_3C	K2
CO3	Explain the properties and applications of ferrous and non-ferrous metals and alloys used in different domains.	K2
CO4	Understand the various heat treatment and strengthening processes.	K2
CO5	Classify composite and nano-materials based on their applications.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	-	1	-	-	-	-	1	1	1	1
CO2	2	2	1	1	2	-	-	-	-	-	-	-	2	-
CO3	3	2	1	2	1	-	-	-	-	-	-	-	1	-
CO4	3	2	2	1	1	-	-	-	-	-	-	-	1	-
CO5	2	1	1	2	2	-	-	-	-	-	1	-	2	1

COURSE CONTENT

UNIT I

Structure of Metals and Constitution of alloys: Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor for cubic structures - SC, BCC, FCC-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size. Imperfections – point, line, Surface and volume. Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

UNIT II

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni, Bi-Cd and Fe-Fe_3C.

UNIT III

Ferrous Metals and Alloys: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron, Nodular cast iron, Alloy cast irons. Classification of steels, properties and applications of plain carbon steels.

Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys.

UNIT IV

Heat treatment of Alloys: Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT V

Composite materials: Introduction, classification of composites, various methods of component manufacture of composites– Hand layup process, Filament winding process, Continuous pultrusion process, Particle – reinforced materials, Fiber reinforced materials, Metal ceramic mixtures, metal – Matrix composites and C – C composites. Nano materials – definition, properties and applications.

TEXT BOOKS

1. Introduction to Physical Metallurgy - Sidney H. Avner, McGrawHill, 2017.
2. Essential of Materials science and engineering - Donald R.Askeland - Cengage.

REFERENCE BOOKS

1. Material Science and Metallurgy for Engineers by V.D Kodgire and S.V Kodgire 39th Edition.
2. Materials Science and Engineering, Callister & Balasubramaniam, Wiley Publishers, 2nd Edition.
3. Material Science for Engineering Students, Fischer, Elsevier Publishers, 1st Edition.
4. Materials Science and Engineering V. Raghavan Prentice-Hall of India Pvt. Ltd., 5th Edition 2004.

WEB RESOURCES

1. http://nptel.ac.in/courses/113105024/7.
2. http://nptel.ac.in/courses/113106031/17.
3. http://nptel.ac.in/courses/112104122/12.
4. http://nptel.ac.in/courses/113104068/36.

II Year I Semester
MECHANICS OF SOLIDS

Course Category	Professional Core	**Course Code**	20ME3T06
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To study the various types of stresses and strains subjected to axial loading and understand the strain energy concepts.
2	To study different beams, draw the shear force, bending moment diagrams and correlate the shear force, bending moment and rate of loading.
3	To study the bending and shear stresses on various cross sections of the beam.
4	To determine slope, deflection at any point on the determinate beams using various methods and stresses due to torsion.
5	To calculate stresses developed in thin and thick cylinders subjected to internal pressure and also to test the buckling and stability of columns based on Euler's and Rankine's Theories.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain various types of stresses due to axial loading and the concept of strain energy.	K2
CO2	Develop shear force and bending moment diagrams for determinate beams subjected to different types of loads.	K3
CO3	Analyze the bending and shear stresses on different cross sections of the beams.	K4
CO4	Examine the slope and deflection of the beam by various methods subjected to point load, UDL, and uniformly varying loads and stresses due to torsion.	K4
CO5	Determine the stresses in thin and thick cylinders subjected to internal pressure and also can be able to find the stability of the columns	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	1	-	-	-	-	-	-	1	1
CO2	3	3	2	2	1	1	-	-	-	-	-	-	1	1
CO3	3	3	2	2	1	1	-	-	-	-	-	-	1	1
CO4	3	3	2	2	1	1	-	-	-	-	-	-	1	1
CO5	3	3	2	2	1	1	-	-	-	-	-	-	1	1

COURSE CONTENT

UNIT I

Simple Stresses & Strains: Types of stresses & strains – Hooke's law – stress – strain diagram for ductile and brittle materials – Factor of safety – Poisson's ratio & volumetric strain – Relation between elastic constants - Bars of varying section – composite bars – Temperature stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses (both analytical and graphical methods). Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT II

Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L, uniformly varying loads and combination of these loads – Point of contraflexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT III

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$, Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT IV

Deflection of Beams: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load.

Torsion: Introduction – Derivation of torsion equation - Torsion of Circular shafts – Stresses and strains in pure Shear.

UNIT V

Thin & Thick Cylinders: Thin cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders. Thick cylinders – Lame's equation – cylinders subjected to inside & outside pressures.

COLUMNS: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

TEXT BOOKS

1. Mechanics of Materials, Ferdinand P Beer, Johnston, Dewolf and Mazurek, 7th Edition, Mc Graw Hill.
2. Strength of Materials, S. Ramamrutham, Dhanpat Rai and Co. Publications, 18th Edition

REFERENCE BOOKS

1. Strength of Materials, U.C. Jindal, Umesh Publications, 1st Edition.
2. Strength of Materials, D S Prakash Rao, Volume 1, University Press.
3. Strength of Materials, R.K.Bansal, Laxmi Publications, 4th Edition.
4. Strength of Materials, Andrew Pytel and Ferdinond L. Singer Longman, 4th Edition.
5. Mechanics of Materials, Gere & Timoshenko, CBS Publications, 2nd Edition.

WEB RESOURCES

1. http://nptel.ac.in/courses/112107147/1
2. http://nptel.ac.in/courses/112107147/7
3. http://nptel.ac.in/courses/112107147/23
4. http://nptel.ac.in/courses/105106116/
5. https://en.wikipedia.org/wiki/Strength_of_materials

II Year I Semester
FLUID MECHANICS & HYDRAULIC MACHINES

Course Category	Professional Core	**Course Code**	20ME3T07
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To study different fluid properties and Manometers.
2	To learn about the different types of fluid flows, flow patterns, forces behind the flow, energy equation, Momentum equation and also to find the losses occurs in flow through the pipes.
3	To study the concept of boundary layer theory and hydrodynamic forces acting on vanes along with their performance evaluation.
4	To study different types of hydraulic turbines, draft tube theory, efficiency, governing and performance characteristics.
5	To study types of Pumps, work done, efficiency, performance of pumps & characteristic curves.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the basic concepts of fluid properties and the concepts of Buoyancy.	K1
CO2	Apply the Continuity, Momentum and energy equations to applications of Fluid Mechanics	K3
CO3	Understand the Boundary layer theory, flow separation and dimensional analysis.	K2
CO4	Examine the performance of hydraulic turbines like Pelton wheel, Francis turbine and Kaplan turbine.	K4
CO5	Evaluate the performance of Centrifugal pump and Reciprocating Pump.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	3	3	-	-	-	-	-	-	-	1	-	1
CO3	3	3	1	-	-	2	2	-	-	-	-	3	1	-
CO4	3	3	1	-	-	2	2	-	-	-	-	3	-	2
CO5	3	3	1	-	-	2	2	-	-	-	-	3	-	2

COURSE CONTENT

UNIT I

Fluid statics: Dimensions and units: physical properties of fluids-specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmosphere, gauge and vacuum pressure, Measurements of pressure – Manometers – Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and flotation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT II

Fluid Kinematics: Introduction, flow types, Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

Fluid dynamics: surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application, force on pipe bend.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes-pipes in series and pipes in parallel-total energy line-hydraulic gradient line.

UNIT III

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles. Basic concepts of dimensional analysis.

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

UNIT IV

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design- draft tube-theory-functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT V

Centrifugal pumps: classification, working, work done- manometric head-losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

Reciprocating pumps: classification, Working, Discharge, slip, indicator diagrams.

TEXT BOOKS

1. Fluid Mechanics- Fundamentals and Applications, Y.A.Cengel & J.M.Cimbala, Tata McGrawhill, 2008.
2. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Lakshmi Publications, 9th Edition.

REFERENCE BOOKS

1. Fluid Mechanics, F.M.White, Tata Mc Graw Hill, 3rd Edition.
2. Hydraulics and Fluid Mechanics including Hydraulics Machines, P. N. Modi, S. M. Seth, Standard Book House Publishers, 14th Edition.
3. Fluid Mechanics and Fluid Power Engineering, D.S.Kumar, S.K. Kataria & Sons Publications.
4. Engineering Fluid Mechanics K L Kumar, Eurasia Publishing House.
5. Fluid Mechanics: Including Hydraulic Machines, A.K.Jain, Khanna Publications, 12th Edition.

WEB RESOURCES

1. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078Page1.html
2. http://ga.water.usgs.gov/edu/hyhowworks.html
3. http://nptel.iitm.ac.in/courses/105101082/;
4. http://www.learnerstv.com/video/Free-video-Lecture-2630-Engineering.html
5. http://www.learnerstv.com/video/Free-video-Lecture-2654-Engineering.html

II Year I Semester

METALLURGY AND MATERIAL SCIENCE LABORATORY

Course Category	Professional Core	**Course Code**	20ME3L04
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Metallurgy and Material Sciences	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To impart students with Knowledge of preparation of Various Compositions of Materials using Muffle Furnace.
2	To impart practical exposure on the microstructures of various materials and their hardness evaluation.
3	To impart knowledge of assessment of simple properties (like Strength, Hardness, etc) of the Billet materials made from Muffle Furnace.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Make a Billet (Cylindrical sample of the Iron and Copper family materials)	K3
CO2	Understand and differentiate microstructures of ferrous & non-ferrous alloys.	K2
CO3	Asses the properties of the samples taken from the Muffle Furnace	K3

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	2	-	1	-	-	-	-	-	1
CO2	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO3	3	1	-	2	3	2	1	2				3	2	1

LIST OF EXPERIMENTS:

1. Preparation and study of the Microstructure of Pure Iron.
2. Preparation and study of the Microstructure of Iron Alloy(s).
3. Preparation and study of the Microstructure of Al.
4. Preparation and study of the Microstructure of Al Alloy(s).
5. Preparation and Study of the Microstructure of Pure Copper.
6. Preparation and Study of the Microstructure of Copper Alloy (Brass).
7. Preparation and Study of the Microstructure of Copper Alloy (Bronze).
8. Study of the Microstructure of Heat Treated Steels.
9. To find the hardness of various Treated & Untreated Iron, its Alloy materials.
10. To find the hardness of various Treated & Untreated Copper, its Alloy materials.
11. To find the hardness of various Treated & Untreated Aluminum, its Alloy materials

II Year I Semester
MECHANICS OF SOLIDS LABORATORY

Course Category	Professional Core	**Course Code**	20ME3L05
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Mechanics of Solids	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To study the behavior of materials under tension, compression, torsion, bending, shear and impact.
2	To study the behavior of springs under tension and compression.
3	To apply loads to various materials under different equilibrium conditions.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Determine modulus of elasticity of bars, beams and springs subjected to various loads.	K3
CO2	Calculate deflection and stiffness of helical spring.	K3
CO3	Examine the behaviour of the solid bodies subjected to various types of loading.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	2	3	-	-	-	-	-	-	3	3	-

COURSE CONTENT

1. Direct Tension Test On Universal Testing Machine (Utm).
2. Compression Test on Wood on Universal Testing Machine (Utm).
3. Bending Test on Simply Supported Beam. (I)Mild Steel. (Ii) Wood.
4. Bending Test On Cantilever Beam Made Of Mild Steel/Aluminum/Brass/Stainless Steel.
5. Torsion Test.
6. Tension Test on springs.
7. Compression Test on springs.
8. Impact Charpy Test.
9. Impact Izod Test.
10. Brinell‟S Hardness Test.
11. Rockwell Hardness Test.

Additional Experiments:

1. Double Shear Test On Universal Testing Machine.
2. Punch Shear Test.

Note: Any 10 Experiments Out Of 11 To Be Conducted

II Year I Semester

FLUID MECHANICS & HYDRAULIC MACHINERY LABORATORY

Course Category	Professional Core	**Course Code**	20ME3L06
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Fluid Mechanics and Hydraulic Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES

To impart practical exposure on the performance evaluation methods of various flow measuring equipment, hydraulic turbines and pumps.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply the fundamental principles of fluid mechanics, calculations involving basic flow measuring devices like venture meter, Orifice meter and major and minor losses of fluid flow through the pipes.	K3
CO2	Estimate the optimum efficiency of a given turbine under different load and (or) speed conditions and to analyze the trends depicted by characteristic curves obtained from the experiments.	K4
CO3	Estimate the optimum efficiency of a given pump under different load and (or) speed conditions and to analyze the trends depicted by characteristic curves obtained from the experiments.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	3	-	-	3	3	-	-	-	-	-	3	-
CO2	3	-	-	2	-	-	-	-	-	-	-	-	3	-
CO3	-	-	3	3	-	3	2	-	-	-	-	-	3	-

LIST OF EXPERIMENTS

1. Calibration of Venturimeter.
2. Calibration of Orificemeter.
3. Determination of Friction factor for a given pipe line.
4. Losses in pipe fittings.
5. Impact of jet on vanes.
6. Performance test on Pelton wheel-constant head.
7. Performance test on Pelton wheel-constant speed.
8. Performance test on Francis turbine-constant head.
9. Performance test on Francis turbine-constant speed.
10. Performance test on Single stage centrifugal pump.
11. Performance test on Multi stage centrifugal pump.
12. Performance test on Reciprocating pump.

Note: Any 10 of the above 12 experiments are to be conducted.

II Year I Semester
BASICS OF APPLIED ROBOT CONTROL

Course Category	SOC	**Course Code**	20ME3S01
Course Type	Skill Oriented	**L-T-P-C**	0-0-4-2
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	00 50 50

COURSE OBJECTIVES	
1	To understand the kinematics and coordinate transformation.
2	To follow the guidelines for accessing the robot and program it for desired task.
3	First-hand experience on industrial robots for the students to learn with industry-driven production requirements.
4	To train students in the field of Industrial Robotics, upgrading skill sets of the students to global standards.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the importance of robot dynamics and plan robot motions and paths.	K2
CO2	Familiarize with the most common robot sensors and understand fundamental sensor processing.	K2
CO3	Perform kinematics analysis of robot systems.	K3
CO4	Create, modify and execute different robot programs	K3

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	-	3	-	-	-	2	-	-	3	3	-
CO4	3	3	3	-	3	-	-	-	3	-	-	3	3	-

COURSE CONTENT

1. Robot mechanics and kinematics.
2. Robot motion control and controller functions.
3. Robot end arm tooling.
4. Sensors and adaptive functions.
5. Robot performance and programming.
6. Robot programming and simulation for pick and place operations.
7. Robot programming and simulation for colour identification.
8. Robot programming and simulation for commissioning and palletizing.
9. Robot programming and simulation for assembly of wind shields.
10. Robot programming and simulation for welding.

II Year I Semester
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
(Common to all branches)

Course Category	Humanities including Management	**Course Code**	20HM3T06
Course Type	Theory	**L-T-P-C**	2 -0-0-0
Prerequisites		**Internal Assessment**	100M

Course Outcomes		**Cognitive Level**
On successful completion of the course, the student will be able to		
CO 1	Understand the concept of Traditional knowledge and its importance	K1
CO 2	Know the need and importance of protecting traditional knowledge	K1
CO 3	Know the various enactments related to the protection of traditional knowledge	K1
CO 4	Understand the concepts of Intellectual property to protect the traditional knowledge	K1
CO 5	Understand the importance of Traditional Knowledge in the development of different sectors	K1

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program												
Outcomes: 1 – Low, 2 - Medium, 3 – High												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	2	0	0	3	0	1	0	2	0	0
CO2	0	0	2	0	0	2	0	2	1	0	0	2
CO3	0	0	1	0	0	3	2	3	1	2	0	1
CO4	0	0	0	0	0	2	1	3	1	1	0	1
CO5	1	0	1	0	0	3	1	1	1	3	0	1

COURSE CONTENT

UNIT I
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II
Protection of Traditional Knowledge: The need for protecting traditional knowledge -Significance of Traditional knowledge Protection-Role of government to harness Traditional Knowledge

UNIT III
Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.Geographical indications act 2003.

UNIT IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

REFERENCE BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya
4. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
5. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
6. Pramod Chandra, India Arts, Howard Univ. Press, 1983.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.

WEB RESOURCES:

1. https://www.wipo.int/wipo_magazine/en/2017/01/article_0004.html
2. http://iks.iitgn.ac.in/wp-content/uploads/2016/01/Indian-Knowledge-Systems-Kapil-Kapoor.pdf
3. https://www.wipo.int/edocs/mdocs/tk/en/wipo_grtkf_ic_21/wipo_grtkf_ic_21_ref_facilitators_text.pdf

II Year II Semester

COMPLEX VARIABLES & STATISTICAL METHODS

(Common to CE & ME)

Course Category	Basic Sciences	**Course Code**	20BM4T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To familiarize the complex variables
2	To familiarize the students with the foundations of probability and statistical methods.
3	To equip the students to solve application problems in their disciplines

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	find the differentiation and integration of complex functions used in engineering problems.	K2
CO2	make use of the Cauchy residue theorem to evaluate certain integrals	K3
CO3	apply discrete and continuous probability distributions	K3
CO4	design the components of a classical hypothesis test	K4
CO5	infer the statistical inferential methods based on small and large sampling tests	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Functions of a complex variable and Complex integration:** Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method. Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs) and problems on above theorems

UNIT II	**Series expansions and Residue Theorem:** Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. Types of Singularities: Isolated – Essential –Pole of order m– Residues – Residue theorem (without proof) – Evaluation of real integral of the types $\int_{-\infty}^{\infty} f(x)dx$ and $\int_{c}^{c+2\pi} f(cos\theta,\ sin\theta)d\theta.$
UNIT III	**Probability and Distributions:** Review of probability and Bayer's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.
UNIT IV	**Sampling Theory:** Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Representation of the normal theory distributions – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.
UNIT V	**Tests of Hypothesis:** Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

TEXT BOOKS	
1.	**B. S. Grewal,** Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017. **.**
2.	**Miller and Freund's,** Probability and Statistics for Engineers, Pearson,7th edition, 2008.
REFERENCE BOOKS	
1.	**J. W. Brown and R. V. Churchill**, Complex Variables and Applications, 9th edition, Mc-Graw Hill, 2013.
2.	**S.C. Gupta and V.K. Kapoor**, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons Publications, 2012. .
3.	**Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
4.	Shron **L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
5.	**Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4thEdition, Academic Foundation,2011
WEB RESOURCES	
1.	**UNIT I:** https://en.wikipedia.org/wiki/Complex_analysis
2.	**UNIT II:** https://en.wikipedia.org/wiki/Contour_integration http://mathonline.wikidot.com/complex-power-series
3.	**UNIT III:** https://en.wikipedia.org/wiki/Normal_distribution https://en.wikipedia.org/wiki/Sampling_(statistics) https://nptel.ac.in/courses/111104073/
4.	**UNIT IV:** https://en.wikipedia.org/wiki/Statistical_hypothesis_testing
5.	**UNIT V:** https://machinelearningmastery.com/statistical-hypothesis-tests/

II Year II Semester
APPLIED THERMODYNAMICS

Course Category	Professional Core	**Course Code**	20ME4T08
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Thermodynamics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To make the student familiarize with the reasons and effects of various losses that occurs in the actual engine operation & Understand the basic working of IC Engine - Components.
2	To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to evaluate the several engine operating parameters that affect the smooth engine operation.
3	To make students learn about different types of compressors and to calculate power and efficiency of Compressors.
4	Basic components used in steam power plant cycles and & Selecting appropriate nozzle for maximum mass flow rate and steam turbine.
5	Basic principle for jet propulsion, rocket and their performance evaluation.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand various Air standard cycles Vs Actual Cycles & Classify various IC Engines and elucidate its components.	K2
CO2	Analyze the performance of CI and SI engines.	K4
CO3	Explain the working of Compressor along with factors influencing its performance.	K3
CO4	Classify steam nozzles and condensers based on various applications.	K2
CO5	Evaluate the performance jet population engine.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	-	1	1	-	-	-	-	-	2	2
CO2	3	3	2	3	-	-	1	-	3	3	-	2	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	1	3	1
CO4	3	2	1	1	-	2	-	-	-	-	-	2	1	2
CO5	2	1	1	2	-	-	2	-	-	-	2	2	2	1

COURSE CONTENT

UNIT I

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

I. C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbo charging, DTSI technology.

UNIT II

Combustion in S.I. Engines : Normal Combustion and abnormal combustion; Importance of flame speed and effect of engine variables; Type of Abnormal combustion, pre-ignition and knocking (explanation)

Combustion in C.I. Engines: Four stages of combustion; Delay period and its importance; Effect of engine variables; Diesel Knock; Need for air movement; suction; compression and combustion induced turbulence in Diesel Engines.

Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT III

Compressors – Classification – positive displacement and roto dynamic machinery – Power producing and power absorbing machines, fan, blower and compressor – positive displacement and dynamic types – reciprocating and rotary types.

Reciprocating compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

Rotary compressors: Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation.

Axial Flow Compressors: Mechanical details and principle of operation

UNIT IV

Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.

Steam Nozzles: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.

Steam Condensers: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirement.

UNIT V

JET PROPULSION: Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on T-S diagram - thrust, thrust power and propulsion efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods. Rockets: Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

TEXT BOOKS:

1. I.C. Engines / V. ganeshan - TMH

3. Heat engines, Vasandani & Kumar publications Thermal machines and *Heat Engines*.
4. Thermal Engineering – R K Rajput-Lakshmi Publications.
5. Thermodynamics and Heat Engines, Volume 2 - R.Yadav- Central book depot

REFERENCE BOOKS:

1. IC Engines – M.L. Mathur & R.P. Sharma – Dhanpath Rai & Sons
2. I.C. Engines – Applied Thermo sciences – C.R. Ferguson & A.T. Kirkpatrick-2nd Edition Wiley Publications
3. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
4. Thermal Engineering-P.L.Ballaney/ Khanna publishers.
5. Thermal Engineering-M.L.Marthur & Mehta/Jain bros

WEB RESOURCES:

1. https://nptel.ac.in/courses/112104033/
2. https://nptel.ac.in/courses/112103277/
3. https://nptel.ac.in/courses/112107216/

II Year II Semester
KINEMATICS OF MACHINERY

Course Category	Professional Core	**Course Code**	20ME4T09
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand the kinematics of different mechanisms and their constraints motion.
2	To study planar and spatial mechanisms.
3	To determine velocity and acceleration of different parts in a given mechanism by using graphical as well as analytical techniques.
4	To generate different cam profiles and study the transmission of power through belt drives.
5	To understand the concepts of gears and gears trains.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate the concepts of different mechanisms and their motion constraints.	K2
CO2	Develop straight line motion mechanisms and steering gear mechanisms.	K3
CO3	Determine the kinematic analysis of simple mechanisms.	K3
CO4	Develop cam profiles based on the prescribed follower motion and perform kinematic analysis on cams with specified contours.	K3
CO5	Illustrate gear terminology, gear types and analyse gear trains.	K4

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	1	1	1	-	-	-	-	-	-	-	1	1	-
CO4	3	1	1	1	-	-	-	-	-	-	-	1	1	-
CO5	3	1	1	1	-	-	-	-	-	-	-	1	1	-

COURSE CONTENT

UNIT I

Mechanisms and Machines: Introduction: Mechanism and machine; Rigid and resistant bodies; Link; Kinematic pair; Degrees of freedom; Classification of kinematic pairs; Kinematic chain; Linkage, mechanism and structure; Mobility of mechanisms. Application of Kutzbach Criterion to Plane Mechanisms. Grubler's

Criterion for Plane Mechanisms. Grashoff's law.
Inversions of Mechanisms: The four-bar chain; single and double slider crank chains.

UNIT II

Mechanism with Lower Pairs: Pantograph - straight line motion mechanisms – exact straight-line motion mechanisms- Peaucellier mechanism, Approximate straight-line motion mechanisms, Watt mechanism. Condition for correct steering- Davis & Ackerman's steering gear mechanisms.
Hooke's Joint: Ratio of shaft velocities - maximum and minimum speed of driven shaft - condition for equal speeds -Angular acceleration of driven shaft - Double Hooke's joint.

UNIT III

Velocity Analysis: Relative velocity method - velocity of point on a link- application of relative velocity method to simple mechanisms - rubbing velocity of a joint – Instantaneous center method - body centrode and space centrode - velocity of point on a link by Instantaneous center method, location of Instantaneous center - three centers in line theorem and its application for simple mechanisms.
Acceleration Analysis: Acceleration diagrams of a link- acceleration diagrams for simple mechanisms- Coriolis component of acceleration - acceleration diagram for slotted lever quick return mechanism.

UNIT IV

Cams: Classification of followers and cams -terms used in radial cams - displacement, velocity and acceleration diagrams when the follower moves with uniform velocity, uniform acceleration and retardation, simple harmonic motion -construction of cam profiles.
Belt Drives: Introduction, Belt and rope drives, selection of belt drive- types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt.

UNIT V

Toothed Gearing: Classification of toothed wheels - terms used in gears - law of gearing - velocity of sliding of teeth - forms of teeth - Cycloidal and involute teeth- length of path of contact-arc of contact-contact ratio- interference in involute teeth - minimum number of teeth to avoid interference.
Gear Trains: Simple, compound and reverted gear trains - epicyclic gear train – velocity ratio of epicyclic gear train - sun and planet wheels - torques in epicyclic gear train - Differential of an automobile.

TEXT BOOKS

1. Theory of Machines, S. S. Rattan, McGraw-Hill Publications, 3rd Edition.
2. Theory of Machines, Thomas Bevan, CBS Publishers & Distributors, 3rd Edition.

REFERENCE BOOKS

1. Theory of Machines and Mechanisms, Shigley J. E. and John Joseph Uicker, Oxford University Press, 3rd Edition.
2. Theory of Machines, R.K. Bansal & J.S. Brar, Laxmi publications (P) LTD, 5th Edition.
3. Theory of Machines, Sadhu Singh , Pearson, 3rd Edition.
4. Mechanism and Machine Theory, J. S. Rao and R. V. Dukkipati, New Age International, 2nd Edition.
5. Theory of Mechanisms and Machines, A Ghosh & A K Malik, 3rd Edition, East West Press.

WEB RESOURCES

1. www.mekanizmalar.com
2. www.museum.kyoto-u. ac.jp
3. Makezine.com
4. https://nptel.ac.in/courses/112105236/21
5. https://nptel.ac.in/courses/112105236/34
6. https://nptel.ac.in/courses/112104121/
7. https://nptel.ac.in/courses/112106137/pdf/2_1.pdf.

II Year II Semester
PRODUCTION TECHNOLOGY

Course Category	Professional Core	**Course Code**	20ME4T10
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Workshop Laboratory	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand fundamentals of casting concepts
2	To provide insight into sand casting and introduce other casting processes
3	To impart knowledge on different welding processes.
4	To understand about the importance of rolling, forging and sheet metal operations.
5	To learn the basics of plastic and ceramics processing.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the working principle of different metal casting processes and gating system.	K2
CO2	Illustrate preparation of moulds as per casting design considerations to minimize defects.	K2
CO3	Explain the different welding processes for joining the parts to fabricate the final product.	K2
CO4	Identify different metal forming processes and their application in real time.	K3
CO5	Distinguish plastics and ceramics to produce required parts.	K3

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	-	1	-	-	-	-	-	-	1	2
CO2	2	2	1	1	1	-	-	-	-	-	-	-	2	-
CO3	3	2	1	1	1	1	-	-	-	-	-	-	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	-	1	-
CO5	2	1	2	2	2	1	-	-	-	-	-	-	2	2

COURSE CONTENT
UNIT -I
Introduction: Importance and Classification of manufacturing processes. Casting Processes: Steps involved in making a casting, Advantage of casting and its applications. Pattern: Types, materials used for pattern

and allowance. Cores: Types of cores, core prints, principles and design of gating system, Gating ratio.

UNIT – II

Melting and Casting Processes: Methods of melting and types of furnaces, Solidification of castings, Risers- Types, function and design, casting design considerations, basic principles and applications of shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

UNIT – III

Welding Processes: Classification of welding processes, types of welds and welded joints, weld bead geometry. Fusion welding: Basic principles of Arc welding and its types, Gas welding, Types of flames, Oxy – Acetylene Gas cutting, Thermit welding, Electron Beam welding, Laser beam welding. - Applications, advantages and disadvantages. Pressure welding: Resistance welding- Spot welding, seam welding, butt welding, projection welding; Solid State welding- Forge welding, Friction welding, Friction stir welding, Explosive welding; Heat affected zones in welding; Welding defects: causes and remedies. Soldering and brazing.

UNIT – IV

Sheet Metal Forming: Introduction, nature of plastic deformation, hot and cold working of metals; Sheet metal working operations: Blanking, piercing, bending, stamping. Spring back and its remedies. Coining, Spinning, types of presses and press tools. Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements. Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing. Forging: Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects.

UNIT – V

Plastics: Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding. Ceramics: Classification of ceramic materials, properties and their application, ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; secondary processing of ceramics: Coatings, finishing.

TEXT BOOKS

1. Manufacturing Technology – Volume I, P.N.Rao 5th Edition, McGraw-Hill Education.
2. Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Mikell P. Groover, John Wiley and Sons Inc, 4th Edition.

REFERENCES

1. Manufacturing Engineering and Technology, Kalpak Jain S and Schmid S.R. Pearson, 8th Edition
2. Manufacturing processes, Amitabha ghosh and Malik, East west press, 2nd Edition
3. Production Technology, P.C.Sharma ,S Chand Publishing, 8th Edition.
4. Process and Material of Manufacture ,Roy A Lindberg , PHI, 4th Edition.
5. Production Engineering-K.C. Jain, A.K. Chitale , PHI, 2nd Edition.

WEB REFERENCES

1. http://nptel.ac.in/courses/112107145/4
2. http://nptel.ac.in/courses/112107145/5
3. http://nptel.ac.in/courses/112107145/7
4. http://nptel.ac.in/courses/112107145/23#
5. https://onlinecourses.nptel.ac.in/noc19_me52

II Year II Semester
MACHINE DRAWING

Course Category	Professional Core	**Course Code**	20ME4T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Drawing	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To provide basic understanding of Conventional representation, sections, joints, simple mechanical parts.
2	The student will be able to draw the assembly from the individual part drawing.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level***
CO1	Illustrate different kinds of materials and mechanical components conventionally.	K2
CO2	Model the assembly drawing using part drawings.	K3

*K1- Remembering, K2- Understanding, K3- Applying, K4- Analyzing, K5- Evaluating, K6- Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	2	-	1	-	-	-	1	2	-	-	1	-
CO2	2	-	-	-	2	-	-	-	1	2	-	-	1	-

COURSE CONTENT	
PART A	**Conventional representation of materials and components:** • Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs, symbols for weldments. • Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned. • Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. • Keys, Cotter joints and knuckle joint. • Riveted joints for plates. • Shaft coupling, spigot and socket pipe joint. • Journal, pivot and collar Pedestal Bearing (Plummer Block) and foot step bearings.

PART B	**Assembly Drawings:** Drawings of assembled views for the part drawings of the following, using conventions and easy drawing proportions. **Engine parts:** Stuffing box, Cross head, Eccentric, Petrol Engine connecting rod and Piston. **Other machine parts:** Screws jack, Machine Vice, Plummer block and Tool post. **Valves:** Steam stop valve, Spring loaded safety valve, Feed check valve and air cock.

Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts

TEXT BOOKS	
1	Machine Drawing –K.L. Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers, 6th Edition.
2	Machine Drawing: Includes Auto CAD – Ajeet Singh/McGraw Hill Education, 2nd Edition.
REFERENCE BOOKS	
1	Machine Drawing by N.D.Bhatt, V.M. Panchal Charotar Publications, 50th Edition.
2	Machine Drawing, O.P Jahkar, Amit Mathur, Khanna Publishing House, 1st Edition.
3	Machine Drawing, S.Gill, Katson Books,2017.
4	Machine Drawing, KC John, PHI,2009.
5	Fundamentals of Machine Drawing, Sadhu Sign , PL Sah, PHI,2nd Edition.
WEB RESOURCES	
1	http://gt3.bme.hu/wp-content/uploads/2016/02/Narayana-Machine_Drawing.pdf

II Year II Semester
DRAFTING AND MODELLING LABORATORY

Course Category	Professional Core	**Course Code**	20ME4L07
Course Type	LABORATORY	**L-T-P-C**	0-0-3-1.5
Prerequisites	CAEDP, MD	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To provide knowledge on modelling methods and procedures.
2	To impart training on solid modelling software.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Gain knowledge on modelling methods and procedures.	K3
CO2	Create 3D part and assembled views of various mechanical components.	K3

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	3	3	-	2	3	-
CO2	3	3	3	-	2	-	-	-	3	3	-	2	3	-

COURSE CONTENT

A) DRAFTING: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances, Study of DXE, IGES files.

B) SURFACE MODELLING - Generation of various Surfaces using surface modelling.

C) The following contents to be done by any 3D software package:

(i) PART MODELLING: Generation of various 3D models through Pad, revolve, shell, sweep, parent child relation, Boolean operations and various standard translators.

(ii) ASSEMBLY DRAWINGS: (Any four of the following using solid model software)
Generation of various Parts/assemblies like Screw Jack, Oldham's Coupling, Foot step bearing, Couplings, knuckle and cotter joints, Crankshaft, Connecting Rod, Piston and Cylinder.

Packages to be provided to cater to drafting, modeling & analysis from the following:
AutoCAD, CATIA, CREO, Solidworks, Fusion 360 etc.

II Year II Semester
THERMAL ENGINEERING LABORATORY

Course Category	Professional Core	**Course Code**	20ME4L08
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Thermodynamics	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To provide hands on experience in operating various types of internal combustion engines and understand their functioning and performance

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Estimate the performance of the I.C. Engine and prepare heat balance sheet	K4
CO2	Estimate the performance of the reciprocating compressor	K4
CO3	Understand the sequence of operations to assemble/disassemble an IC engine & study the various processes associated with the performance of boilers.	K2

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	-	-	1	2
CO2	2	2	2	-	-	-	-	-	1	-	-	-	1	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	-	2

LIST OF EXPERIMENTS

1. I.C. Engines valve timing diagram and port timing diagrams.
2. Performance test on 4 stroke diesel engine.
3. Performance test on 2 stroke petrol engine.
4. Evaluation of friction power by conducting Morse test on 4 stroke multi cylinder engine.
5. Determination of Friction Power by retardation or motoring test on IC engine.
6. Preparation of Heat balance sheet on IC Engines at different loads.
7. Economical speed test of an IC engine.
8. Performance test on variable compression ratio engine.
9. Performance test on reciprocating air compressor unit.
10. Disassembly / assembly of different parts in an IC Engine.
11. Study of boilers, mountings and accessories.
12. Performance test on Refrigeration test rig.

Note: Total 10 experiments should be conducted from the above 12 experiments

II Year II Semester
PRODUCTION TECHNOLOGY LABORATORY

Course Category	Professional Core	**Course Code**	20ME4L09
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Production Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES

To impart hands-on practical exposure on manufacturing processes and equipment.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Prepare the pattern, mould and casting.	K3
CO2	Perform different welding operations and plastic parts processing operations	K3
CO3	Perform sheet metal operations and bending operations.	K3

K1: Remembering, K2: Understanding, K3: Applying, K4: Analyzing, K5: Evaluating, K6: Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	1	-	1	-	1	1
CO2	3	3	3	2	-	-	-	-	1	-	1	-	1	1
CO3	3	3	3	2	-	-	-	-	1	-	1	-	1	1

COURSE CONTENT

A. Metal Casting Process:
1. Pattern making.
2. Sand testing - for strength.
3. Mould preparation.
4. Melting and Casting.

B. Welding:
1. Manual metal arc welding - Lap Joint.
2. Manual metal arc welding - Butt Joint.
3. Resistance Spot Welding.
4. Brazing and soldering.
5. Gas cutting.
6. TIG/MIG Welding.
7. Gas welding.

C. Processing of Plastics:
1. Injection Moulding.
2. Blow Moulding

D. Metal Forming:

1. Study of simple, compound and progressive dies.
2. Blanking & Piercing operations and
3. Deep drawing and extrusion operations.
4. Bending and other operations.

[Note: Total 10 experiments should be conducted, at least two from A, B, C & D]

II Year II Semester
NUMERICAL METHODS THROUGH PYTHON
(For ME only)

Course Category	SOC	**Course Code**	20CS4S08
Course Type	Skill Oriented	**L-T-P-C**	0-0-4-2
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	00 50 50

COURSE OBJECTIVES	
1	To acquire programming skills in core Python and to acquire Object Oriented Skills in Python
2	To develop the skill of designing Graphical user Interfaces in Python
3	To develop the ability to write database applications in Python

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Write, Test and Debug Python Programs and Use Conditionals and Loops for Python Programs	K4
CO2	Use functions and represent Compound data using Lists, Tuples and Dictionaries	K3
CO3	Use various applications using python	K3

Note: K1- Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	-	-	-	2	3	3
CO2	3	2	1	1	1	-	-	-	-	-	-	2	3	3
CO3	3	2	1	1	1	-	-	-	-	-	-	2	3	3

COURSE CONTENT

1. To find the roots of non-linear equation using Bisection method
2. To find the roots of non-linear equation using Newton Raphson’s method.
3. Curve fitting by least – square approximations
4. To solve the system of linear equations using Gauss - elimination method
5. To solve the system of linear equations using Gauss - Siedal method

6. To solve the system of linear equations using Gauss - Jordan method
7. To integrate numerically using Trapezoidal rule
8. To integrate numerically using Simpsons rule
9. To find the largest Eigen value of a matrix by Power – method
10. To find numerical solution of ordinary differential equations by Euler's method
11. To find numerical solution of ordinary differential equations by Runge-Kutta method
12. To find numerical solution of ordinary differential equations by Milne's method
13. To find the numerical solution of Laplace equation
14. To find the numerical solution of Wave equation
15. To find the solution of a tri-diagonal matrix using Thomas algorithm
16. To fit a straight using least square technique

III Year I Semester
DYNAMICS OF MACHINERY

Course Category	Professional Core	**Course Code**	20ME5T12
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Mechanics & Kinematics of Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand static and dynamic forces of planar mechanisms and flywheel design
2	To understand the concept of friction on clutches, brakes and dynamometers
3	To impart the knowledge on balancing of rotary and reciprocating masses
4	To understand the effect of precession on the stability of moving vehicles and various types of governors used for controlling the speed of engines
5	To equip knowledge on vibrations and their importance in design of machine structures

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze static and dynamic forces of planer mechanism and design of flywheel for regulating the speed of engine and machines	K4
CO2	Apply the concept of friction and analyze the performance of clutches, brakes and dynamometers.	K3
CO3	Understand the concept of balancing of rotating and reciprocating masses and analyze the undesirable effects of unbalanced forces of rotating and reciprocating masses resulting from prescribed motions	K4
CO4	Apply the concept of gravity and centrifugal governors to control the speed of the engines and analyze the stabilization of sea vehicles, aircrafts and automobiles	K4
CO5	Analyze the effect of vibration on beams and shafts with various load distributions	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	2	2	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-		1
CO3	1	3	2	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	1	-	-	-	-	-	-	-	-	-	2	1
CO5	-	3	1	1	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT

UNIT I
STATIC AND DYNAMIC FORCE ANALYSIS

Static and Dynamic Force analysis of Planar mechanisms, Inertia forces and D-Alembert's Principle, Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, turning moment diagrams – fluctuation of energy – fly wheels and their design.

UNIT II

CLUTCHES, BRAKES AND DYNAMOMETER

Clutches: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

Brakes and Dynamometers: Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

UNIT III

BALANCING

Balancing of rotating masses – single and different planes, use analytical and graphical methods. Balancing of primary and secondary unbalanced forces of reciprocating masses, Effect of partial balancing of two-cylinder locomotives, variation of tractive force, swaying couple and hammer blow.

UNIT IV

MECHANISM FOR CONTROL

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves.

Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

UNIT V

VIBRATIONS

Free Vibration of spring mass system – Natural frequency - types of damping – damped free vibration, Simple problems on forced damped vibration, Vibration Isolation & Transmissibility, Whirling of shafts, critical speeds, torsional vibration, two rotor and three rotor systems.

TEXT BOOKS

1. Theory of Machines, S.S Rattan, McGraw Hill, 2014.
2. Theory of machines, Khurmi, R, S. Chand & Co. Ltd., New Delhi 2005, 14th edition, 2005.

REFERENCE BOOKS

1. Mechanism and Machine Theory, JS Rao and RV Dukkipati, New Age Publications.
2. Theory of Machines, John J. Dicker, Jr., Gordon R. Pennock, Joseph E. Shigley, Oxford university press.

WEB RESOURCES

1. nptel.ac.in/courses/112104114/
2. nptel.ac.in/courses/112101096/
3. nptel.ac.in/syllabus/112104114/
4. www.nptelvideos.in/2012/12/dynamics-of-machines.html

III Year I Semester
DESIGN OF MACHINE MEMBERS-I

Course Category	Professional Core	**Course Code**	20ME5T13
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics, Mechanics ofSolids, Material Science.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand the fundamental design concepts and apply the theories of failures to evaluate the strength of the machine element
2	To learn strength of the machine components subjected to static and variable loads by using different failure theories.
3	To study the basic principles for design of machine elements such as temporary and permanent joints.
4	To understand various joints subjected to combined loading for shaft design.
5	To study various shaft couplings subjected to torsion.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the design procedure and find the stresses in machine components.	K4
CO2	Apply the loads on machine members and analyze the variable stresses to ensure safe design.	K4
CO3	Determine and analyze the stresses in temporary and permanent joints under various loading conditions.	K4
CO4	Determine and analyze the stresses in different shaft joints along with keys under various loading conditions.	K4
CO5	Design and analyze the shaft couplings for various engineering applications.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	-	-	-	-	-	-	1	1
CO2	2	1	1	2	1	2	-	-	-	-	-	-	2	-
CO3	2	1	2	1	3	2	-	-	-	-	-	1	1	2
CO4	2	2	1	2	3	2	-	-	-	-	-	1	2	1
CO5	2	1	2	2	3	2	-	-	-	-	-	1	2	1

COURSE CONTENT

UNIT I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses – combined stresses – torsional and bending stresses – impact stresses – stress strain relation – various theories of failure – factor of safety – design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations – static strength design based on fracture toughness.

UNIT II

STRENGTH OF MACHINE ELEMENTS: Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – goodman's line – soderberg's line – modified goodman's line.

UNIT III

RIVETED & WELDED JOINTS - Types of riveted heads and riveted joints- Lap Joint – Butt joint– Design of riveted joints with initial stresses - Strength of parallel fillet and Transverse fillet welded joints- Welded joint: Eccentric loading.

BOLTED JOINTS – Design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – both of uniform strength, different seals, Caulking and Fullering.

UNIT IV

KEYS, COTTERS AND KNUCKLE JOINTS: Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- knuckle joints.

SHAFTS: Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code. Use of internal and external circlips, gaskets and seals (stationary & rotary).

UNIT V

SHAFT COUPLING: Types of shaft couplings-Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

TEXT BOOKS

1. Design of Machine Elements / V.M. Faires/McMillan publisher, 4th edition.
2. Machine Design/V.Bandari/ TMH Publishers, 3rd edition.

REFERENCE BOOKS

1. Machine Design: An integrated Approach / R.L. Norton / Pearson Education, 2nd Edition.
2. Mechanical Engineering Design by Shigley, McGraw Hill 10th Edition.
3. Elements of Machine Design N.C.Pandya, C.S.Shaw, Charotar Publishing House Pvt Ltd, 15th Edition.
4. Machine Design by Schaum‟s, Mc Graw Hill series, 1st Edition.
5. Machine Design data book by B.B. Bandari, Mc Graw Hill, 1st Edition.

WEB RESOURCES

1. http://nptel.ac.in/courses/112105124/5
2. http://nptel.ac.in/courses/112105124/7
3. http://nptel.ac.in/courses/112105124/20
4. http://nptel.ac.in/courses/112105124/35
5. http://nptel.ac.in/courses/112105124/13

III Year I Semester
MACHINING, MACHINE TOOLS AND METROLOGY

Course Category	Professional Core	**Course Code**	20ME5T14
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Production Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To provide the fundamental knowledge and principles in material removal processes
2	To apply the fundamentals and principles of metal cutting to practical applications through machine tools
3	To demonstrate the fundamentals of machining processes and machine tools.
4	To Learn about the factors affecting measurements and various tolerances
5	To Known the working principle and applications of various linear and angular measuring instruments.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply the fundamentals of metal removal processes, metal cutting forces and geometry of the cutting tools.	K2
CO2	Explain the working principle, mechanism and various operations performed on lathe, shaping, slotting and planning machines	K2
CO3	Compare the mechanisms of various operations performed by milling, drilling and boring machines.	K2
CO4	Explain the factors affecting measurements and various tolerances used in manufacturing processes	K3
CO5	Apply the working principles of linear and angular measurements for industrial applications.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	-	1	1	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	1	-	-	-	-	-	-	-	-
CO3	2	1	-	-	1	1	-	-	-	-	-	-	-	-
CO4	2	1	-	1	1	-	-	2	-	-	-	-	1	-
CO5	2	1	-	1	1	-	-	2	-	--	-	-	1	-

COURSE CONTENT
UNIT I
FUNDAMENTALS OF MACHINING

Elementary treatment of metal cutting theory, element of cutting process, geometry of single point tool and angles chip formation and types of chips, built up edge and its effects, chip breakers: Mechanics of orthogonal cutting, Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, machinability, tool materials.

UNIT II

MACHINE TOOL-I

Engine lathe, Principle, specification, types, work and tool holding devices, Automatic lathes, classification: Single spindle and multi-spindle automatic lathes and its tool layouts; Shaping, slotting and planning machines, Principles of working, specification, operations performed.

UNIT III

MACHINE TOOL-II

Milling machine, classifications, specifications, working principles of milling machines; Geometry of milling cutters, methods of indexing, kinematic scheme of milling machines. Drilling and boring machines, principles of working, specifications, types, operations performed, twist drill.

UNIT IV

GEOMETRICAL DIMENSIONING AND TOLERANCES

Systems of Limits and Fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types, unilateral and bilateral tolerance system, hole and shaft basis systems, Interchangeability and selective assembly; Linear Measurement: Slip gauges, dial indicator, micrometers; Measurement of angles and tapers: Bevel protractor, angle slip gauges, spirit levels, sine bar.

UNIT V

MEASURING INSTRUMENTS

Optical measuring instruments: Tool maker's microscope and its uses, collimators, optical projector, interferometer; Screw thread measurement: Element of measurement, errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, profile thread gauges; Surface roughness measurement**:** Numerical assessment of surface finish: CLA, R.M.S Values, Rz values, methods of measurement of surface finish: profilograph, talysurf - ISI symbol for indication of surface finish.

TEXT BOOKS

1. Workshop Technology – B.S.RaghuVamshi – Vol II
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
3. R. K. Jain, Engineering Metrology, Khanna Publishers, 1st Edition,2013
4. Dr. R. Kesavan, Dr. R. Kesavan, "Machine Tools" Laxmi publications, 2nd Edition, 2016

REFERENCE BOOKS

1. N. K Mehta, "Metal Cutting and Design of Cutting Tools, Jigs & Fixtures",McGraw-Hill Education, 1st Edition,2014
2. M Mahajan "A Textbook of Metrology ", Dhanpatrai and Co, 2nd Edition, 2013
3. R. S. Sirohi, H. C. Radha Krishna, "Mechanical Measurements", New Age Publishers, 3rdEdition, 2011
4. N. K Mehta, "Metal Cutting and Design of Cutting Tools, Jigs & Fixtures",McGraw-Hill Education, 1st Edition,2014.

WEB RESOURCES

1. http://www.nptel.ac.in/courses/112106138.
2. https://nptel.ac.in/courses/112105233
3. https://nptel.ac.in/courses/112107242

III Year I Semester
INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Category	Professional Elective	**Course Code**	20ME5T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn basic principles of management and factors with respect to plant location
2	To learn the concepts of plant layouts and operation management
3	To understand the importance and techniques in quality control
4	To understand the concepts related to human resource management, industrial disputes and labour welfare
5	To apply the techniques of project management and know the importance of value analysis

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Know the importance of industrial management and plant location	K2
CO2	Design plant layouts and minimise the production time	K3
CO3	Chose proper control techniques to improve product quality	K3
CO4	Understand the methods of performance rating of human resources, their management and concepts related to industrial disputes.	K2
CO5	Apply suitable technique for enterprise resource planning and project management	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	2	2	-	-	-	-	-	-	2	-	1	-
CO3	2	1	3	2	-	-	-	2	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	1	-
CO5	-	1	-	-	-	-	-	2	-	-	3	-	-	-

COURSE CONTENT

UNIT I

MANAGEMENT AND ORGANIZATION: Definition – meaning and nature of management- Functions of management, Taylor's Scientific management- Fayol's Principles of management- Basic concepts related to organization-Departmentation, Delegation and Decentralization, Type of organization structures-authority, responsibility and accountability.

PLANT LOCATION: Factors governing plant location, comparison of rural and urban sites.

UNIT II

PLANT LAYOUT: Types of production layouts, process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and breakdown maintenance, types of plant layout-various data analyzing forms-travel chart.

OPERATIONS MANAGEMENT: Importance, types of production, applications, work study, method study and time study, PMTS, micro-motion study, rating techniques, MTM, principles of Ergonomics,

flow process charts, string diagrams and Therbligs.

UNIT III

STATISTICAL QUALITY CONTROL: Quality control, its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – X and R – charts X and S charts and their applications, numerical examples.

TOTAL QUALITY MANAGEMENT: zero defect concept, quality circles, implementation, applications, ISO quality systems. Six sigma – definition, basic concepts.

UNIT IV

INDUSTRIAL RELATIONS & LABOR WELFARE: Definition of Industrial dispute – causes of Industrial dispute– (Internal & External) – machinery to solve industrial disputes, grievance management, attendance and leave, labor Act-2003, Factories Act-1948, workmen's Compensation Act- 1923.

RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types.

UNIT V

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

PROJECT MANAGEMENT: PERT, CPM – differences & applications, critical path, determination of floats, importance, project crashing, smoothing and numerical examples.

TEXT BOOKS

1. Industrial Engineering and management by O.P Khanna, Khanna Publishers.
2. Industrial Engineering and Production Management, Martand Telsang, S.Chand & Company Ltd. New Delhi

REFERENCE BOOKS

1. Industrial Engineering by Banga & Sharma.
2. Principles of Management by Koontz O‟ Donnel, McGraw Hill Publishers.
3. Statistical Quality Control by Gupta.

WEB RESOURCES

1. http://www.nptelvideos.in/2012/12/industrial-engineering.html
2. https://www.managementstudyguide.com/value-analysis.html
3. https://managementhelp.org/projectmanagement/

III Year I Semester
AUTOMATION IN MANUFACTURING

Course Category	Professional Elective	**Course Code**	20ME5T16
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn the strategies of automation in manufacturing.
2	To understand the concept of automated flow lines.
3	To classify various assembly system and line balancing and various automated material handling and storage systems.
4	To understand the concept of adaptive control systems.
5	To study the various components in automated systems & various inspection methods.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identify the basic fundamentals of strategies in automation, pneumatic and hydraulic components.	K2
CO2	Discuss various automated flow lines, methods of part transfer mechanism, buffer mechanism.	K2
CO3	Differentiate various assembly system and line balancing and various automated material handling and storage systems.	K2
CO4	Recognize adaptive control systems.	K2
CO5	Discuss about automated control systems and various inspection methods	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	2	-	-	-	2	-	-	-	2	-
CO2	3	2	2	-	2	-	-	-	2	-	-	-	2	-
CO3	3	2	2	-	2	-	-	-	2	-	-	-	2	-
CO4	3	2	2	-	2	-	-	-	1	-	-	-	1	-
CO5	3	2	2	-	2	-	-	-	2	-	-	-	1	-

COURSE CONTENT

UNIT I
INTRODUCTION: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing and machine tool control.

UNIT II
AUTOMATED FLOW LINES: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines**.**

UNIT III

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT IV

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

UNIT V

AUTOMATED INSPECTION: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision.

TEXT BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover. PE/PHI.
2. Groover.M.P, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Publications

REFERENCE BOOKS

1. Computer Control of Manufacturing Systems by YoramCoren.
2. CAD / CAM/ CIM by Radhakrishnan.
3. W. Buekinsham," Automation", PHI Publications, 3rd edition

WEB RESOURCES

1. https://nptel.ac.in/courses/112/103/112103293/
2. https://nptel.ac.in/courses/112/104/112104288/
3. https://www.youtube.com/watch?v=v-3TmN4HhLc

III Year I Semester
ADVANCED MATERIALS

Course Category	Professional Elective	**Course Code**	20ME5T17
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Basic understanding of composite materials and reinforcements.
2	Detail explanation of different polymer composites and their applications
3	Knowledge on manufacturing methods of composite materials.
4	Detail explanation on laminates and its macro-mechanical analysis.
5	Basic understanding of Nano materials and their applications.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the fundamentals of different composite materials.	K2
CO2	Classify different composite materials with their applications.	K2
CO3	Illustrate various manufacturing methods of composite materials.	K3
CO4	Analyze macro-mechanical structure of a lamina.	K4
CO5	Illustrate Nano materials and their applications.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	1	2	2	1	1	-	-	-	-	-	-	-	2	-

COURSE CONTENT

UNIT I
INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: Polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber-reinforced composites and nature-made composites, and applications.
REINFORCEMENTS: Fibers- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibers.

UNIT II
Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

UNIT III
MANUFACTURING METHODS: Autoclave, tape production, molding methods, filament winding, man layup, pultrusion, RTM.

UNIT IV

MACROMECHANICAL ANALYSIS OF A LAMINA: Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.

UNIT V

NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages- applications in comparison with bulk materials (nano – structure, wires, tubes, composites). State of art nano advanced – topic delivered by student.

TEXT BOOKS

1. Nano material by A.K. Bandyopadyay, New age Publishers.
2. Materials Science and Engineering: An Introduction - William D Callister Jr

REFERENCE BOOKS

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.

WEB RESOURCES

1. http://nptel.ac.in/courses/113105057/2
2. http://www.nptelvideos.in/2012/12/advanced-materials-and-processes.html

III Year I Semester
NANO TECHNOLOGY

Course Category	Professional Elective	**Course Code**	20ME5T18
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering physics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
Students will learn	
1	Understand the basic scientific concepts of nano science.
2	Understand the properties of nano materials characterization of materials.
3	Understand the synthesis and fabrication.
4	Understand the characterization techniques
5	Understand the applications of nano technology in various science, engineering and technology fields.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Define the essential concepts used in nanotechnology	K1
CO2	List out the material properties	K1
CO3	Explain the syntheses and fabrication	K2
CO4	Demonstrate the characterization techniques	K2
CO5	Recall applications in various fields	K1

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	1	2	1	-	-	-	-	-	1	1	1
CO2	2	-	-	1	2	-	-	-	-	-	-	-	2	-
CO3	2	-	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	3	2	1	-	-	-	-	-	-	-	2	1
CO5	2	1	3	2	2	-	-	-	-	-	-	-	1	2

COURSE CONTENT

UNIT I

INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

UNIT II

PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto-electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

UNIT III

SYNTHESIS AND FABRICATION: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom-Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top-Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nanostructures.

UNIT IV

CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezo response microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

UNIT V

CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond-nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, and applications of carbon nano tubes.

APPLICATIONS OF NANO TECHNOLOGY: Applications in material science, surface science, energy and environment. Applications of quantum dots.

TEXT BOOKS

1. Nano science and nano technology by M.S Ramachandra Rao, Shubra Singh, Wiley publishers.

REFERENCE BOOKS

1. Introduction to Nano Technology by Charles P. Poole, Jr.,Frank J.Owens, Wileypublishers.
2. Nanotechnology by Jermy J Ramsden, Elsevierpublishers.
3. Nano Materials- A.K.Bandyopadhyay/ New AgeIntrodu.
4. Nano Essentials-T.Pradeep/TMH.
5. Nanotechnology the Science of Small by M.A Shah, K.A Shah,Wiley Publishers.
6. Principles of Nanotechnology by Phani Kumar,Scitech.

WEB REFERENCE:

1. https://nptel.ac.in/courses/113/106/113106093/
2. https://nptel.ac.in/courses/118/107/118107015/

III Year I Semester
SURVEYING

Course Category	Open Elective	**Course Code**	20CE5T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Introduce the students to basic principles of surveying.
2	Demonstrate the basic surveying skills.
3	Perform various methods of linear and angles measurements.
4	Enable the students to use surveying equipment's
5	Integrate the knowledge and produce topographical map.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate the fundamentals in chain and plane table surveying.	K2
CO2	Identify the angles on filed by compass survey.	K2
CO3	Apply knowledge of leveling in surveying.	K3
CO4	Measure the horizontal and vertical angles by using Theodolite and Total Station instruments.	K3
CO5	Estimate the volume and area of irregular boundaries of filed.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	1	-	-	-	-	3	-	-	2	3	-	3
CO2	3	3	1	2	-	-	-	-	2	-	-	3	3	-	3
CO3	2	-	-	3	-	-	-	-	3	-	-	-	2	-	2
CO4	2	3	1	3	3	-	-	-	3	-	-	3	3	-	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

COURSE CONTENT

UNIT I

INTRODUCTION: Definition-Uses of surveying, Objectives, Principles and Classificationsof Surveying – Errors in survey measurements.

DISTANCEMEASUREMENTCONVENTIONS AND METHODS: Use of chain and tape, Errors and corrections to linear measurements, overview of plane table surveying.

UNIT II

COMPASS SURVEY: Definition- Principles of Compass survey - Meridians, Azimuths and Bearings, declination. Computation of angle - Purpose and types of Traversing - traverse adjustments – Local attraction.

UNIT III

LEVELING: Concept and Terminology, Levelling Instruments and their Temporary and permanent adjustments- method of levelling.

CONTOURING: Characteristics and uses of contours- methods of conducting contour surveys and their plotting.

UNIT IV

THEODOLITE: Theodolite, description, principles - uses – temporary and permanent adjustments, measurement of horizontal and vertical angles. Principles of Electronic Theodolite – Omitted Measurements. Introduction to geodetic surveying - Total Station and Global Positioning System.

CURVES: Types of curves, design and setting out.

TACHEOMETRIC SURVEYING: Stadia and tangential methods of Tachometry.

MODERN SURVEYING METHODS: Principle and types of E.D.M. Instruments, Total station advantages and Applications. Introduction to Global Positioning System.

UNIT V

COMPUTATION OF AREAS AND VOLUMES: Computation of areas along irregular boundaries and regular boundaries. Embankments and cutting for a level section and two- level sections with and without transverse slopes, determination of the capacity of reservoir,
volume of barrow pits.

TEXT BOOKS

1. Surveying (Vol No.1, 2 &3) by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) ltd, New Delhi.
2. Text book of Surveying by C. Venkataramaiah, University press, India (P) limited.

REFERENCE BOOKS

1. Text book of Surveying by S.K. Duggal (Vol No. 1&2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Text book of Surveying by Arora (Vol No. 1&2), Standard Book House, Delhi.

WEB RESOURCES

1. https://lecturenotes.in/notes/2827-note-for-surveying-1-s-1-by-swadhina-priyadarsini
2. https://nptel.ac.in/courses/105107122/1
3. https://nptel.ac.in/courses/105107158/

III Year I Semester
RENEWABLE ENERGY ENGINEERING

Course Category	Open Elective	**Course Code**	20EE5T13
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics
2	To understand the concept of Wind Energy Conversion & its applications
3	To study the principles of biomass and geothermal energy
4	To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it
5	To study the various chemical energy sources such as fuell cell and hydrogen energy along with their operation and equivalent circuit

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.	K4
CO2	Illustrate the components of wind energy systems.	K3
CO3	Illustrate the working of biomass, digesters and Geothermal plants.	K3
CO4	Demonstrate the principle of Energy production from OTEC, Tidal and Waves.	K3
CO5	Evaluate the concept and working of Fuel cells & MHD power generation.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	1	-	-	-	-	1	2	2
CO2	3	2	1	1	-	-	1	-	-	-	-	1	2	2
CO3	3	1	1	1	-	-	1	-	-	-	-	1	2	2
CO4	3	1	1	1	-	-	1	-	-	-	-	1	2	2
CO5	3	1	1	1	-	-	1	-	-	-	-	1	2	2

COURSE CONTENT

UNIT I

Solar Energy: Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT II

Wind Energy: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT III

Biomass and Geothermal Energy:

Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

UNIT IV

Energy From oceans, Waves & Tides:

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.

Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.

Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT V

Chemical Energy Sources:

Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications

Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

TEXT BOOKS

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013

REFERENCE BOOKS

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015

WEB RESOURCES

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://nptel.ac.in/courses/103/107/103107157/

III Year I Semester
PRINCIPLES OF COMMUNICATION ENGINEERING

Course Category	Open Elective	**Course Code**	20EC5T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The Fundamentals of Analog Communication Systems
2	The Generation and Detection of Angle Modulation Techniques
3	The Digital Modulation Techniques
4	The knowledge in measurement of information and various codes for communication systems
5	Fundamentals of Microwave, Satellite, Optical and Mobile Communications

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the basics of Analog communication system	K2
CO2	Understand the Angle Modulation Techniques	K2
CO3	Understand the basics of Analog communication system	K2
CO4	Apply the knowledge of digital electronics and understand the error control coding techniques.	K3
CO5	Understand different types of communication systems and its requirements.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT

UNIT I
Basic blocks of Communication System. Analog Modulation-Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC, AM transmitters and receivers.

UNIT II
Angle Modulation-Frequency and Phase Modulation. Transmission Band width of FM signals, Methods of generation and detection, FM Transmitters and Receivers.

UNIT III
Sampling theorem, Pulse Modulation Techniques-PAM, PWM and PPM concept, PCM System, Delta Modulation, Digital Modulation Techniques-(ASK, FSK, PSK, QPSK).

UNIT IV
Error control coding techniques–Basics of Information Theory, Linear block codes-Encoder and

decoder, Hamming Code, Cyclic codes–Encoder, Syndrome Calculator, Convolution codes.

UNIT V

Modern Communication Systems–Microwave communication systems, Optical communication system, Satellite communication system, Mobile communication system.

TEXT BOOKS

1. Communication Systems (Analog And Digital) | Sanjay Sharma, S.K.Kataria& Sons, 2013
2. Communication Systems, Simon Haykins, John Wiley,3rdEdition,1995

REFERENCE BOOKS

1. Shulin Daniel, 'Error Control Coding', Pearson, 2ndEdition,2011
2. B.P.Lathi and ZhiDing, 'Modern Digital and Analog Communication Systems', OUPUSA Publications, 4thEdition,2009

WEB RESOURCES

1. https://nptel.ac.in/courses/117105143/15
2. http://www.nptelvideos.in/2012/12/digital-communication.html

III Year I Semester
DEEP LEARNING

Course Category	Open Elective	**Course Code**	20AM5T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Learn deep learning methods for working with sequential data.
2	Learn deep recurrent and memory networks.
3	Learn deep Turing machines.
4	Apply such deep learning mechanisms to various learning problems.
5	Know the open issues in deep learning, and have a grasp of the current research directions.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.	K1
CO2	Discuss the Neural Network training, various random models**.**	K2
CO3	Explain the Techniques of Keras, TensorFlow, Theano and CNTK.	K3
CO4	Classify the Concepts of CNN and RNN.	K4
CO5	Implement Interactive Applications of Deep Learning.	K5

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	1	-	-	-	-	-	-	2	2	2	3
CO2	2	2	2	1	1	-	-	-	-	-	-	2	1	1	2
CO3	2	1	1	2	2	-	-	-	-	-	-	1	1	1	2
CO4	2	2	2	1	1	-	-	-	-	-	-	1	1	1	2
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	1	3

COURSE CONTENT

UNIT I

Fundamentals of Deep Learning: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines,

Fundamentals of Machine Learning: Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. [**Text Book 2**]

UNIT II

Introducing Deep Learning: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [**Ref Book 1**]

UNIT III

Neural Networks: Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews, Binary Classification,

Classifying newswires, Multiclass Classification. [**Text Book 2**]

UNIT IV

Convolutional Neural Networks: Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation.

Recurrent Neural Networks: Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [**Ref Book 1**]

UNIT V

Interactive Applications of Deep Learning: Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [**Text Book 1**]

Deep Learning Research: Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [**Text Book 1**]

TEXT BOOKS

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courvile, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433

REFERENCE BOOKS

1. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821
2. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412
3. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009
4. Matrix Computations, Golub, G.H., and Van Loan, C.F, JHU Press,2013
5. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004

WEB RESOURCES

1. Swayam NPTEL: Deep Learning: https://onlinecourses.nptel.ac.in/noc22_cs22/preview

III Year I Semester
ENTREPRENEURSHIP

Course Category	Open Elective	**Course Code**	20HM5T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand different Entrepreneurial traits.	K2
CO2	Identify and compare the financial institutions supporting entrepreneurship.	K4
CO3	Understand the functioning and problems faced by MSMEs (Micro Small Medium Enterprises)	K2
CO4	Identify Entrepreneurial opportunities for women.	K3
CO5	Analyze different market, technical factors and prepare a project report based on guidelines.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	1	-	3	2	1	3	3	-	-
CO2	-	-	-	-	-	1	-	3	-	2	3	1	-	-
CO3	-	-	-	-	-	1	1	3	1	1	-	3	-	-
CO4	-	-	-	-	-	1	-	3	1	1	-	3	-	-
CO5	-	1	1	-	-	1	2	3	1	3	3	3	-	-

COURSE CONTENT

UNIT I
Introduction to Entrepreneurship
Introduction to Entrepreneurship: Definition of Entrepreneur Entrepreneurial Traits. Entrepreneur vs. Manager, Creating and Starting the venture: Sources of new ideas, methods of generating ideas, creative problem solving – Writing Business Plan, Evaluating Business Plans.

UNIT-II
Institutional and financial support to Entrepreneurship
Institutional/financial support: Schemes and functions of Directorate of Industries, IFCI, District Industries Centers (DICs), Industrial Development Corporation (IDC), State Financial Corporation (SFCs), Small Scale Industries Development Corporations (SSIDCs). Khadi and Village Industries Commission (KVIC), Technical Consultancy Organization (TCO), Small Industries Service Institute (SISI), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI).(short answers only), Start up culture.

UNIT III
Micro, Small and Medium Enterprises:
Importance and role of MSMEs in economic development, Types of MSMEs, Policies and their support to MSMEs growth and growth strategies.

Sickness in small business and remedies – small entrepreneurs in international business.

UNIT IV

Women Entrepreneurship and Start up Culture

Role & importance, profile of women Entrepreneur, problems of women Entrepreneurs, women Entrepreneurship Development in India - Steps taken by the Government to promote women entrepreneurship in India, Associations supporting women entrepreneurs. Successful Entrepreneurs (case studies).

UNIT V

Project Formulation and Appraisal

Preparation of Project Report –Content; Guidelines for Report preparation – Project Appraisal techniques –economic – Steps Analysis; Financial Analysis; Market Analysis; Technical Feasibility.

TEXTBOOKS

1. Vasanth Desai – Fundamentals of Entrepreneurship and Small business management – Himalaya publishing house – 2019
2. Robert Hisrich, Michael Peters, Dean A. Sheperd, Sabyasachi Sinha – Entrepreneurship - TMH - 2020.

REFERENCE BOOKS

1. Vasant Desai – Entrepreneurship Management - Himalaya Publishing House- 2018.
2. Robert J.Calvin - Entrepreneurial Management – TMH - 2009.
3. Gurmeet Naroola - The entrepreneurial Connection – TMH - 2009.
4. Aruna Kaulgud - Entrepreneurship Management - Vikas publishing house - 2009.

WEB RESOURCES:

1. https://nptel.ac.in/courses/110105067/50
2. http://www.yourarticlelibrary.com/project-management/5-methods-of-project-appraisal-explained/40771
3. https://springhouse.in/government-schemes-every-entrepreneur/

III Year I Semester
MACHINE TOOLS LABORATORY

Course Category	Professional Core	**Course Code**	20ME5L10
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Production Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the knowledge of machining operations on Lathe to fabricate a product	K2
CO2	Develop hands on knowledge and practical learning shaping, slotting, drilling and tapping operations.	K3
CO3	Develop skill in milling and grinding operations in manufacturing industry.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	-	-	-	-	1	-	2	-	3	3
CO2	3	2	3	3	-	-	-	-	1	-	2	-	3	3
CO3	3	2	3	3	-	-	-	-	1	-	2	-	3	3

COURSE CONTENT

1. Plain turning and facing operations on lathe.
2. Step turning and taper turning operation on lathe.
3. Thread cutting and knurling operation on lathe.
4. Drilling operation on lathe.
5. Drilling and tapping operation
6. Shaping and planning operation
7. Slotting operation
8. Milling operation
9. Surface grinding operation on a given work piece
10. Cylindrical grinding operation on a given work piece
11. Grinding of tool angles
12. Introduction to CNC machine tools

Note: At least 10 experiments to be conducted.

III Year I Semester
THEORY OF MACHINES LABORATORY

Course Category	Professional Core	**Course Code**	20ME5L11
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Kinematics of Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	Inspect vibrational behavior of systems
2	Understand the principle of gyroscopes and governors
3	Learn static and dynamic balancing of mechanical systems

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate free and forced vibrational systems	K2
CO2	Analyze the motion of gyroscope and understand working principle of governors	K4
CO3	Apply the concept of static and dynamic balancing in rotating and reciprocating components.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	2	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	2	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	2	-	-	-	-	-	-	2	-

COURSE CONTENT

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system.
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel.
8. To plot follower displacement Vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism.
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency.
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears.

Note: At least 10 experiments to be conducted.

III Year I Semester
SOFT SKILLS AND INTERPERSONAL COMMUNICATION

Course Category	Skill Oriented	**Course Code**	20HE5S01
Course Type	Laboratory	**L-T-P-C**	1-0-2-2
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	00 50 50

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Empowers the personality traits which help for the setting goal and improving quality of life.	K2
CO2	Enhances the required methods and strategies to develop public speaking skills among the learners.	K1
CO3	Builds the confidence in verbal and non-verbal communication besides life skills.	K2
CO4	Strengthens various inter and intra personal abilities to lead better personal and professional career.	K2
CO5	Improves the innate abilities which help for decision-making and problem-solving with emotional intelligence.	K1

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

COURSE CONTENT

UNIT I

1. Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development.
2. Self-Discovery: Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue.
3. Positivity and Motivation: Developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation; Enhancing Motivation Levels.

UNIT-II

1. Interpersonal Communication: Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.
2. Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking.
3. Non-Verbal Communication: Importance and Elements; Body Language.

UNIT III

1. Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness.

2. Group Discussion: Importance, Planning, Elements, Skills assessed; effectively disagreeing, Initiating, Summarizing and Attaining the Objective.
3. Interview Skills: Interviewer and Interviewee – in-depth perspectives. Before, During and After the Interview. Tips for Success.
4. Teamwork and Leadership Skills: Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills

UNIT IV

1. Etiquette and Manners – Social and Business.
2. Time Management – Concept, Essentials, Tips.
3. Personality Development – Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.
4. Leadership and Assertiveness Skills: A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behaviour; Assertiveness Skills.

UNIT V

1. Emotional Intelligence: Meaning, History, Features, Components, Intrapersonal and Management Excellence; Strategies to enhance Emotional Intelligence
2. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods
3. Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills.
4. Stress Management: Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress.

TEXTBOOKS

1. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012.
2. English and Soft Skills – S.P.Dhanavel, Orient Blacks wanIndia, 2010

WEB RESOURCES:

1. https://nptel.ac.in/courses/109107121/
2. https://www.goskills.com/Soft-Skills

III Year I Semester
PROFESSIONAL ETHICS AND HUMAN VALUES

Course Category	Mandatory	**Course Code**	20HM5T07
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand different concepts in Professional Ethics and Human Values.	K2
CO2	Apply ethical principles to resolve the problems that arise in work place.	K3
CO3	Make use of Engineers rights to fulfill their responsibilities.	K3
CO4	Understand the responsibility of an engineer in designing safety.	K2
CO5	Analyze the social media accounts in order to create and maintain a positive digital footprint.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	2	-	-	3	2	3	-	2	-	2	-	-
CO2	-	-	2	-	-	3	2	3	-	1	-	2	-	-
CO3	-	-	2	-	-	3	2	3	-	2	-	2	-	-
CO4	-	-	2	-	-	3	2	3	-	2	-	2	-	-
CO5	-	-	2	-	-	3	2	3	-	1	-	2	-	-

COURSE CONTENT

UNIT I
Professional Ethics and Human values:
Ethics -History of Ethics-Types of Ethics, Professional Ethics and its forms - Morals, Values – Integrity – Civic Virtue –Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time –Co-operation – Loyalty- Collegiality-Commitment – Empathy – Self-confidence – Spirituality-Character.

UNIT II
Engineering & Organization Ethics:
Engineering Ethics-Meaning & Purpose of Engineering Ethics- Consensus and Controversy –Work Place Ethics and Business Ethics –Ethics in HRM, Finance & Marketing – Ethical Theories-Meaning & Uses of Ethical Theories-Theories of moral Development-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

UNIT III
Engineers Responsibilities and Rights:
Key Characteristics of Engineering Professionals – Professional Roles to be played by an Engineer - Ethical egoism-Collective bargaining-Confidentiality- Acceptance of Bribes/Gifts when is a Gift and a Bribe-examples of Gifts v/s Bribes-Whistle Blowing and its types-when should it be attempted-preventing whistle blowing.

UNIT IV

Engineers' Responsibility for Safety and Risk:

Concept of Safety-Types of Safety, Risk-Types of Risks, Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V

Ethical issues in Social Media:

Social Media- Various Social Media Platforms: Google, Facebook, YouTube, Instagram -Social Media set-up and Uses-Ethical use of Social media-Effects of Social Media on Public- Social Media (vs) News-Social Media Fame and Reputation-Trolling, Harassing, and Hating on Social Media-Legal Aspects of Social Media.

REFERENCE BOOKS

1. "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana- Maruthi Publications.
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-Laxmi Publications
4. "Professional Ethics and Human Values" by Prof.D.R.Kiran-
5. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
6. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger -Tata McGraw- Hill -2003
7. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

WEB RESOURCES

1. https://study.com/academy/lesson/ethical-issues-in-internet-social-media-marketing.html
2. https://www.tutorialspoint.com/engineering_ethics/engineering_ethics_rights_of_engineers
3. https://link.springer.com/article/10.1007/s11948-997-0039-x

III Year II Semester
DESIGN OF MACHINE MEMBERS – II

Course Category	Professional Core	**Course Code**	20ME6T19
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Design of machine members-I and Kinematicsof Machinery.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To gain knowledge about various bearings and design procedure of journal, ball and roller bearings.
2	To learn about design and analysis of the engine parts such as cylinder, piston, connecting rod and crankshaft.
3	To impact knowledge on design and analysis of power screws and Stresses applied in different types of beams
4	Learn to design the mechanical systems for power transmission elements such as belts, chain drives and wire ropes.
5	To steps involved in the design procedure of spur and helical gears.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identify suitable bearing based on the application of the loads and predict the life of the bearing.	K3
CO2	Design the engine parts such as cylinder, piston, connecting rod and crankshaft	K4
CO3	Design of power screws subjected to loading and stresses applied in different types of beams.	K4
CO4	Analyze power transmission efficiencies through belts, chains, pulleys and wire ropes.	K4
CO5	Select the appropriate gear for the given operating conditions.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	1	-	-	-	3	-	-	-	-	1	-
CO2	2	2	3	1	-	-	-	3	-	-	-	-	1	-
CO3	2	2	3	2	-	-	-	3	-	-	-	-	1	-
CO4	2	1	3	2	-	-	-	3	-	-	-	-	1	-
CO5	2	1	3	2	-	-	-	3	-	-	-	-	1	-

COURSE CONTENT

UNIT I

BEARINGS: Classification of bearings, applications, types of journal bearings, lubrication, bearing modulus, full and partial bearings, clearance ratio, heat dissipation of bearings, bearing materials, design of journal bearing, ball and roller bearings, static loading of ball & roller bearings, bearing life.

UNIT II

ENGINE PARTS: IC Engine Construction, design of cylinder, cylinder block, piston, connecting rod, cranks and crank shafts - centre and over hung cranks.

UNIT III

DESIGN OF POWER SCREWS: Types of screws – Square, ACME, Buttress, design of screw, nut, and compound screw, design of lead screw and screw Jack.

DESIGN OF CURVED BEAMS: Stresses in curved beams, Expression for radius of neutral axis for rectangular,circular, trapezoidal and T-Section, design of crane hooks and C –clamps.

UNIT IV

POWER TRANSMISSIONS SYSTEMS: Types of belts – flat, V-Vee type and Rope, materials, transmission of power by belt and rope drives, transmission efficiencies, design of belt, design of pulleys for belt, types of chains, types of chains drives and design of chain drive.

WIRE ROPES: Construction, Designation, Stresses in wire ropes, rope sheaves and drums and design of wire rope.

UNIT V

GEAR DRIVES: Types of gears - Spur and Helical, nomenclature of gear, load concentration factor, dynamic load factor, surface compressive strength, bending strength, estimation of centre distance, module and face width, design of spur gear and helical gear, check for plastic deformation, check for dynamic and wear considerations.

TEXT BOOKS

1. Design of Machine Elements by V.Bandari/ Tata McGraw Hill education.
2. Machine Design by T.V. Sundararajamoorthy & N. Shanmugam/ Anuradha Publications.
3. A Text Book of Machine Design by S.Md.Jalaludeen/ Anuradha Publications.

DATA BOOKS (Allowed in Examinations)

1. Machine Design Data Book by S.Md.Jalaludeen/ Anuradha Publications.
2. Design Data Book by PSG College of Technology.

REFERENCE BOOKS

1. Mechanical Engineering Design by Shigley's / Richard Budynas & Keith Nisbett /Tata McGraw Hill education.
2. Machine design an Integrated Approach by Robert L. Norton/ Person Education Limited.
3. Machine design by R.S.Khurmi/ S.Chand.

WEB RESOURCES

1. http://nptel.ac.in/courses/112102015/28
2. http://nptel.ac.in/courses/112104203/31

III Year II Semester
HEAT TRANSFER

Course Category	Professional Core	**Course Code**	20ME6T20
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Thermodynamics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand the basic differential equations of heat transfer in various modes.
2	To learn the heat transfer and temperature distribution of various fins.
3	To know how to use the empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.
4	To understand the boiling, condensation and the concepts of LMTD, NTU for heat exchangers.
5	To learn the concepts of radiation heat transfer.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze the basic Heat transfer concepts and their physical relevance in planes, cylinders and spherical components.	K4
CO2	Analyze the system with fins and 1D transient conduction heat transfer problems.	K4
CO3	Apply fundamental concepts and principles in Convective Heat transfer	K3
CO4	Analyze the performance of heat exchanger using LMTD and NTU method and heat transfer with phase change.	K4
CO5	Analyze radiation heat transfer from an ideal & real surface	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	1	3	1	-	-	-	-	-	-	-	-	-	1	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO5	1	2	1	-	-	-	-	-	-	-	-	-	1	-

COURSE CONTENT

UNIT I

Conduction Heat Transfer and governing laws

Introduction: Modes and mechanisms of heat transfer - Basic laws of heat transfer -General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation - General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates - steady, unsteady and periodic heat transfer - Initial and boundary conditions.

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems- overall heat transfer coefficient - Electrical analogy - Critical radius of insulation

UNIT II

Extended surface & Transient Conduction Heat Transfer

One Dimensional Steady State Conduction Heat Transfer: Extended surface (fins) Heat Transfer - Long Fin, Fin with insulated tip and Short Fin.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance - Significance of Biot and Fourier Numbers -Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body

UNIT III

Forced & Free Convection

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders - Significance of non-dimensional numbers. Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths - Division of internal flow based on this -Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

UNIT IV

Heat Exchangers & Heat Transfer with Phase Change

Heat Exchangers: Classification of heat exchangers - overall heat transfer Coefficient and fouling factor - Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

Heat Transfer with Phase Change: Boiling- Pool boiling - Regimes - Calculations on Nucleate boiling, Critical Heat flux and Film boiling. Condensation - Film wise and drop wise condensation -Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

UNIT V

Radiation Heat Transfer

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation - Irradiation - total and monochromatic quantities - laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann- heat exchange between two black bodies - concepts of shape factor - Emissivity - heat exchange between grey bodies - radiation shields - electrical analogy for radiation networks.

Mass Transfer

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.

TEXT BOOKS

1. Heat and Mass Transfer by R.K.Rajput, S.Chand Publications 3rd Edition.
2. Fundamentals of Engineering Heat and Mass Transfer — R.C. Sachdeva - New Age Intl. Publishers 2ndEdition, 2005.

REFERENCE BOOKS

1. Heat and Mass Transfer- P.K.Nag-TMH 2nd Edition, 2007.
2. Heat transfer - J.P.Holman, Tata McGraw-Hill, 9th Edition, 2010.

DATA HAND BOOK

1. Heat and Mass Transfer Data Book, C.P. Kothandaraman and Subramanian New Age International Publications, 9 h Edition, Reprint 2012.

WEB RESOURCES

1. https://nptel.ac.in/courses/112/105/112105271/
2. https://nptel.ac.in/courses/112/108/112108246/

III B Tech II Semester

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Category	Open Elective	**Course Code**	20AM6T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment**	30
		Semester End Examination Total Marks	70 100

COURSE OBJECTIVES	
The student will:	
1	Identify problems that are amenable to solution by AI methods, and which ML methods may be suited to solving a given problem
2	Formalize a given problem in the language/framework of different AI methods (e.g., as asearch problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the fundamentals of Artificial Intelligence.	K1
CO2	Demonstrate on various various Techniques of Problem Solving.	K2
CO3	Analyze the Knowledge representation Methods. Learn about Machine Learning.	K3
CO4	Illustrate about various Statistical Learning Methods.	K4
CO5	Discuss about Supervised Learning and Linear Methods.	K5

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 –Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	1	-	-	-	-	-	2	1	-
CO2	2	3	1	1	1	-	-	-	-	-	-	1	1	1
CO3	2	3	1	1	1	-	-	-	-	-	-	1	1	1
CO4	2	3	1	2	1	-	-	-	-	-	-	1	1	1
CO5	2	3	1	1	1	-	-	-	-	-	-	1	1	1

COURSE CONTENT	
UNIT-I	**Introduction**- What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.
UNIT-II	**Problem Solving**: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and OptimizationProblems, Searching with Nondeterministic Actions.
UNIT-III	**Knowledge Representation**: Knowledge-Based Agents, Logic, Propositional Logic: A Very SimpleLogic, Ontological Engineering, Categories and Objects. **Introduction**- Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning.

UNIT-IV	**Statistical Learning**: Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator,Empirical Risk Minimization.
UNIT-V	**Supervised Learning**: (Regression/Classification): Basic Methods: Distance based Methods, NearestNeighbours, Decision Trees, Naive Bayes, **Linear Models**: Linear Regression, Logistic Regression, Generalized Linear Models, Support VectorMachines.

TEXT BOOKS	
1.	Stuart Russell and Peter Norvig, ―Artificial Intelligence: A Modern Approach‖, 3rd Edition, Pearson, 2010.
2.	"Machine Learning", Tom M. Mitchell, Tata Mc – Graw Hill Publications, 2nd Edition, 2021.
REFERENCE BOOKS	
1.	SarojKaushik, ―Artificial Intelligence‖, Cengage Learning India, 2011
2.	Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.
WEB RESOURCES:	
1	https:// https://onlinecourses.nptel.ac.in/noc21-cs24/preview

III Year II Semester
OPERATIONS RESEARCH

Course Category	Professional Elective	**Course Code**	20ME6T21
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Applications of operations research through LPP.
2	Formulation of objective function through transportation and assignment problems.
3	How to sequence the jobs and machines while processing and Replacement of machine/equipment.
4	The applications of waiting line problems and operations research through DPP.
5	Deterministic and stochastic models.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Formulate the objective function by linear programming problem and solution through various models.	K3
CO2	Evaluate optimal solutions to the objective function with the knowledge of transportation and assignment problems.	K3
CO3	Apply the sequencing of the jobs on a machine and items replacement**s**	K4
CO4	Apply the principle of dynamic programming and service rate.	K3
CO5	Apply the inventory models in balancing the stock and demand ratio for profits	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	-	-	3	-	3	1
CO2	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO3	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO4	3	3	3	2	3	-	-	-	-	-	3	-	3	2
CO5	3	3	3	1	3	-	-	-	-	-	3	-	3	2

COURSE CONTENT

UNIT I

INTRODUCTION: Development – definition– characteristics and phases – types of operation research models – applications.

ALLOCATION: Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle

UNIT II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy,

ASSIGNMENT PROBLEM – formulation – optimal solution - variants of assignment problem-travelling salesman problem.

UNIT III

SEQUENCING – Introduction – flow –shop sequencing –*n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines.

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT IV

WAITING LINES: Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

UNIT V

INVENTORY: Introduction – single item – deterministic models –purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

TEXT BOOKS

1. Operations Research / S.D.Sharma-Kedarnath
2. Operations Research/S Kalavathy / Vikas Publishers

REFERENCE BOOKS

1. Operations Research / A.M.Natarajan, P. Balasubramani, A.Tamilarasi / Pearson Education.
2. Operations Research / R.Pannerselvam,PHI Publications.
3. Operations Research / Wagner/ PHI Publications.
4. Operations Research / DS Cheema/University Science Press
5. Operations Research / Ravindran, Philips, Solberg / Wiley publishers.

WEB RESOURCES

1. http://www.nptelvideos.in/2012/12/fundamentals-of-operations-research.html
2. https://nptel.ac.in/courses/110106062

III Year II Semester
AUTOMOBILE ENGINEERING

Course Category	Professional Elective	**Course Code**	20ME6T22
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	IC Engines and Turbo Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn functions of different components in Automobiles
2	To impart knowledge on Transmission systems and Steering Systems.
3	To impart the knowledge on ignition system & suspension systems.
4	To impart the knowledge of Braking system and Engine specification.
5	To understand the concept of safety and Engine emission control systems

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the function of various components of automobile.	K2
CO2	Identify the merits and demerits of the various transmission and steering systems.	K2
CO3	Describe the concept of Ignition and Suspension systems.	K2
CO4	Explain the features of Braking system and Engine specification.	K4
CO5	Analyze the Engine emission control standards.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	2	-	-	-	-	-	2	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	1	-	2	2	-	-	-	-	-	2	1
CO5	2	2	1	-	-	-	2	-	-	-	-	1	3	-

COURSE CONTENT

UNIT I

INTRODUCTION: Components of four-wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, oil filters, oil pumps, air filters, Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps, Types of carburetor.

UNIT II

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism,

steering gears – types, steering linkages.

UNIT III

IGNITION SYSTEM: Function of an ignition system, auto transformer, contact breaker points, condenser and spark plug –electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT IV

BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.

ENGINE SPECIFICATION: Introduction-engine specifications with regard to power, speed, torque, no. of cylinders and arrangement.

UNIT V

SAFETY SYSTEMS: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

ENGINE EMISSION CONTROL: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification, exhaust gas treatment thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards.

TEXT BOOKS

1. Automotive Mechanics / Heitner
2. Automobile Engineering / William Crouse, TMH Distributors.
3. Automobile Engineering- P.S Gill, S.K. Kataria& Sons, New Delhi.

REFERENCE BOOKS

1. Automotive Engines Theory and Servicing, James D. Halderman and Chase D. Mitchell Jr., Pearson education inc.
2. Automotive Engineering / Newton Steeds & Garrett.
3. Automotive Mechanics – Vol. 1 & Vol. 2 / Kripal Singh, standard publishers.

WEB RESOURCES

1. https://nptel.ac.in/courses/107/106/107106080/
2. http://gabook.cyou/file/nptel-automobile-engineering
3. https://nptel.ac.in/courses/107/106/107106088/

III Year II Semester
INDUSTRIAL ROBOTICS

Course Category	Professional Elective	**Course Code**	20ME6T23
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To impart knowledge about industrial robots and their configurations.
2	To acquire knowledge about components of industrial robots.
3	To learn programming and kinematics of robotics
4	To familiarize with trajectory planning and control architecture
5	To impart knowledge industrial applications.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain various robots and their configuration related to industries.	K2
CO2	Demonstrate working of various components of industrial robots.	K2
CO3	Illustrate programming and kinematics of robotics	K2
CO4	Make use of trajectory planning and control architecture	K3
CO5	Develop industrial applications in various conditions.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO2	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO3	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO4	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO5	3	3	2	2	-	-	-	-	2	-	-	-	3	-

COURSE CONTENT

UNIT I
Introduction:
Definition of a robot – Automations & Robotics - Basic concepts, types of industrial robots – Robot configurations, SCARA, workspace and work volume – Types of robot drives – Basic robot motions – point to point control, continuous path control - Specifications of robots.

UNIT II
Components of the Industrial Robotics: Line diagram representation of robot, common types of arms. Manipulators - Types of Robot end effectors - Grippers - Tools as end effectors.
Actuators and Sensors: Pneumatic, Hydraulic actuators, electric & stepper motors. Position sensors – potentiometers, resolvers, encoders – Velocity sensors. Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing.
UNIT III
Programming of Robots and Vision System-Lead through programming methods- Teach pendent overview of various textual programming languages like VAL etc.

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H Transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for Industrial robots. Differential Kinematics for planar serial robots

UNIT IV

Trajectory planning: Joint space scheme- Cubic polynomial fit-Obstacle avoidance in operation space-cubic polynomial fit with via point, blending scheme. Introduction Cartesian space scheme. Control-Interaction control, Rigid Body mechanics, Control architecture- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

UNIT V

Industrial Applications:

Present and Future applications of robotics in industry - Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.

TEXT BOOKS

1. Industrial Robotics by Mikell P Groover, Pearson Education.
2. Robotics and Control by Mittal R K &Nagrath I J, TMH Publications.

REFERENCE BOOKS

1. Robotic Engineering – An integrated Approach by Richard D Klafter, Thomas Achmielewski and Mickael Negin, Prentice Hall India, New Delhi, 2001.
2. Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P Groover, Pearson Education, 2015.
3. Robotics Control sensing, Vision and Intelligence by K.S. Fu., R.C. Gonalez, C.S.G. Lee, McGraw Hill International Edition, 1987.

WEB RESOURCES

1. http://www.nptel.ac.in/courses/112101099/1#
2. https://www.toptal.com/robotics/programming-a-robot-an-introductory-tutorial#:~:text=Two%20main%20programming%20languages%20are,tests%20or%20proof%20of%20concepts.
3. https://www.plantautomation-technology.com/articles/different-types-of-robot-programming-languages

III Year II Semester
STATISTICAL QUALITY CONTROL

Course Category	Professional Elective	**Course Code**	20ME6T24
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Industrial engineering management	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To understand the approaches and techniques of quality value and engineering.
2	To interpret statistical process control with $\overline{X}$, R, p, c charts and other types of control charts.
3	To understand tolerance design and quality function deployment.
4	To understand techniques of modern reliability engineering tools.
5	To interpret the concepts of complex system and reliability techniques.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the approaches and techniques of quality value and engineering	K2
CO2	Identify significance of statistical process control with $\overline{X}$, R, p, c charts and other types of control charts.	K2
CO3	Understand tolerance design and quality function deployment.	K2
CO4	Illustrate techniques of modern reliability engineering tools.	K3
CO5	Interpret the concepts of complex system and reliability techniques.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	2	-	-	-	2	-	1	-	2	-
CO2	3	2	2	-	2	-	-	-	2	-	1	-	2	-
CO3	3	2	2	-	2	-	-	-	2	-	1	-	2	-
CO4	3	2	2	-	2	-	-	-	2	-	1	-	2	-
CO5	3	2	2	-	2	-	-	-	2	-	1	-	3	-

COURSE CONTENT

UNIT I
Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.

UNIT II
Statistical process control $\overline{X}$, R, p, c charts, other types of control charts, process capability, process capability analysis, process capability index. (SQC tables can be used in the examination)
Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans.

UNIT III

Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. Online quality control – variable characteristics, attribute characteristics, parameter design.

Quality function deployment – house of quality, QFD matrix, total quality management concepts. Quality information systems, quality circles, introduction to ISO 9000 standards.

UNIT IV

Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

UNIT V

Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness. Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

TEXT BOOKS

1. Quality Engineering in Production Systems / G Taguchi /McGraw Hill
2. Reliability Engineering/ E.BalaGuruswamy/Tata McGraw Hill
3. Statistical Quality Control : A Modern Introduction/ Montgomery/Wiley

REFERENCE BOOKS

1. Jurans Quality planning & Analysis/ Frank.M.Gryna Jr. / McGraw Hill
2. Taguchi Techniques for Quality Engineering/ Philipposs/ McGraw Hill
3. Reliability Engineering / LS Srinath / Affiliated East West Pvt. Ltd.
4. Statistical Process Control/ Eugene Grant, Richard Leavenworth / McGraw Hill
5. Optimization & Variation Reduction in Quality / W.A. Taylor / Tata McGraw Hill
6. Quality and Performance Excellence/ James R Evans/ Cengage learning

III Year II Semester

DISASTER MANAGEMENT

Course Category	Open Elective	**Course Code**	20CE6T40
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To provide basic conceptual understanding of disasters.
2	To understand approaches of Disaster Management.
3	To build skills to respond to disaster.
4	To understand to reduce the intensity of future disasters.
5	To understand the Restoration of human life in the region.

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Knowledge on characteristics of natural disasters
CO2	Planning on approaches of Disaster Management
CO3	Ability to plan and design the new skills in disaster response
CO4	Role of remote sensing system in disaster area response
CO5	Knowledge on the Restoration of human life in the region.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	1	1	-	-	-	-	2	-	3	1	1
CO2	2	2	3	-	1	1	-	-	-	-	2	-	3	1	1
CO3	2	2	3	-	1	1	-	-	-	-	2	-	3	1	1
CO4	2	2	3	-	1	1	-	-	-	-	2	-	3	1	1
CO5	2	2	3	-	1	1	-	-	-	-	2	-	3	1	1

COURSE CONTENT	
UNIT I	**Natural Hazards and Disaster Management**: Introduction of DM – Inter disciplinary nature of the subject– Disaster Management cycle – Five priorities for action. Case study methods of the following: Vegetal Cover floods, droughts – Earthquakes – landslides – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast.
UNIT II	**Man Made Disaster and Their Management Along With Case Study Methods Of The Following:** Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terrorism -threat in mega cities, rail and aircraft accidents, ground water, industries - Emerging infectious diseases and Aids and their management.
UNIT III	**Risk and Vulnerability:** Building codes and land use planning – Social Vulnerability Environmental vulnerability – Macro-economic management and sustainable development, Climate change risk rendition – Financial management of disaster – related losses
UNIT IV	**Role of Technology in Disaster Managements:** Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations-roads and bridges mitigation programme for earth quakes – flowchart, geospatial information in agriculture drought assessment - Multimedia Technology in disaster risk management and training - Transformable Indigenous Knowledge in disaster reduction – Role of RS & GIS

UNIT V	**Multi-sectional Issues, Education and Community Preparedness:** Impact of disaster on poverty and deprivation - Climate change adaptation and human health - Exposure, health hazards and environmental risk-Forest management and disaster risk reduction -The Red cross and red crescent movement - Corporate sector and disaster risk reduction- Education in disaster risk reduction Essentials of school disaster education - Community capacity and disaster resilience-Community based disaster recovery - Community based disaster management and social capital-Designing resilience- building community capacity for action

TEXT BOOKS	
1.	"Disaster Management guide lines", GOI-UND Disaster Risk program (2009-2012)
2.	Modh S. (2010) "Managing Natural Disasters", Mac Millan publishers India LTD.
REFERENCE BOOKS	
1.	Murty D.B.N. (2012) "Disaster Management", Deep and Deep Publication PVT.Ltd. New Delhi
WEB RESOURCES	
1	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

III Year II Semester
FUNDAMENTALS OF ELECTRIC VEHICLES

Course Category	Open Elective	**Course Code**	20EE6T19
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
2	To understand various power converters used in electric vehicles.
3	To know various architecture of hybrid electric vehicles.
4	To be familiar all the different types of motors suitable for electric vehicles.
5	To have knowledge on latest developments in strategies and other storage systems.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate different types of electric vehicles..	K3
CO2	Select suitable power converters for EV applications.	K2
CO3	Design HEV configuration for a specific application.	K4
CO4	Choose an effective method for EV and HEV applications.	K3
CO5	Analyze a battery management system for EV and HEV	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	-	-	2	2	-	-	-	-	2	1	1
CO2	2	3	-	-	-	1	1	-	-	-	-	-	2	2
CO3	-	3	-	-	-	1	-	-	-	-	2	2	1	2
CO4	3	2	-	-	-	2	1	-	-	-	2	-	1	2
CO5	2	-	-	-	-	2	-	-	-	-	-	2	2	2

COURSE CONTENT	
UNIT 1	**Introduction** Fundamentals of vehicles - Components of conventional vehicles - drawbacks of conventional vehicles – Need for electric vehicles - History of Electric Vehicles – Types of Electric Vehicles – Advantages and applications of Electric Vehicles.
UNIT 2	**Components of Electric Vehicles** Main components of Electric Vehicles – Power Converters - Controller and Electric Traction Motor – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.
UNIT 3	**Hybrid Electric Vehicles** Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs - Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples - Merits and Demerits.
UNIT 4	**Motors for Electric Vehicles** Characteristics of traction drive - requirements of electric machines for EVs – Different motors suitable for Electric and Hybrid Vehicles – Induction Motors –

	Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only)
UNIT 5	**Energy Sources for Electric Vehicles** Batteries - Types of Batteries – Lithium-ion - Nickel-metal hydride - Lead-acid – Comparison of Batteries - Battery Management System – Ultra capacitors – Flywheels – Fuel Cell – it's working.

TEXT BOOKS	
1	Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2	Denton - Tom. Electric and hybrid vehicles. Rutledge - 2020.
REFERENCE BOOKS	
1	Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2	Chau - Kwok Tong. Electric vehicle machines and drives: design - Analysis and Application. John Wiley & Sons - 2015.
3	Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge university press - 2015
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108106170
2	https://inverted.in/blog/fundamentals-of-electric-vehicles

III Year II Semester
SENSORS AND TRANSDUCERS

Course Category	Open Elective	**Course Code**	20EC6T26
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: By studying this course the student will learn	
1	The principle of various Transducers and their construction
2	The transducer construction, classification, principle of operation and characteristics
3	About transducers for measurement of physical parameters
4	Temperature measurement using transducers
5	Applications and principles of operation, standards and units of measurements

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Discuss role of transducers and Sensor in instrumentation	K1
CO2	Descriptive view for the transducer construction, classification, principle of operation and characteristics.	K2
CO3	Gain knowledge about transducers for measurement of displacement, strain, velocity, analyze transducers for measurement of pressure, force and flow	K3
CO4	Analyze transducers for measurement of Temperature	K4
CO5	Analyze sensors used in industrial applications	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	2	-	1	-	-	-	-	-	-	-
CO2	1	2	2	-	1	-	-	-	-	-	-	-
CO3	2	2	2	-	2	-	-	-	-	-	-	-
CO4	2	3	2	-	2	-	-	-	-	-	-	-
CO5	3	3	3	-	2	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Introduction:** Functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics. Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input
UNIT II	**Transducers for motion and dimensional measurements:** Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, synchros, capacitance transducers, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers, Gyroscopic sensors

UNIT III	**Transducers For Force Measurement**: Bonded strain gauge transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers. **Transducers For Flow Measurement:** Hot wire and hot-film anemometers, Electro-magnetic flow meters, laser Doppler velocity meter **Transducers For Pressure Measurement:** Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers.
UNIT IV	**Transducers For Temperature Measurement:** Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, Thermistors, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors, Transducers for liquid level measurement, humidity, silicon and quartz sensors, fiber optic sensors.
UNIT V	**Smart sensors:** Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for Environmental Monitoring

TEXT BOOKS	
1.	Sensors and Transducers, D. Paranaiba, PHI Learning Private Limited.
2.	Mechatronics, W. Bolton, Pearson Education Limited.
REFERENCE BOOKS	
1.	Transducers and Instrumentation, by D.V.S. Murthy (PHI)
2.	Instrumentation Measurement & Analysis, by B.C. Nakra, K.K. Choudry, (TMH)
WEB RESOURCES	
1.	https://youtu.be/hv-aBonZMRQ
2.	https://www.youtube.com/watch?v=qSa3GNjIyy0

III Year II Semester
COMPUTER FORENSICS

Course Category	Open Elective	**Course Code**	20CS7T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Identify Security Risks and Take Preventive Steps
2	Understand the Forensics Fundamentals
3	Understand the Evidence Capturing Process

COURSE OUTCOMES		**BTL**
Upon successful completion of the course, the student will be able to:		
CO1	Understand the Cybercrime Fundamentals	K2
CO2	List the types of attacks on networks	K4
CO3	Analyze various tools available for Cybercrime Investigation	K4
CO4	Summarize the Computer Forensics and Investigation Fundamentals and tools	K2
CO5	Analyze the legal perspectives of Cybercrime	K4

K1- Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	1	-	2	-	-	-	-	2	2	2
CO2	3	2	2	2	2	1	-	2	-	-	-	-	2	2	2
CO3	3	2	2	2	2	1	-	2	-	-	-	-	2	2	2
CO4	3	2	2	2	2	1	-	2	-	-	-	-	2	2	2
CO5	3	2	2	2	2	1	-	2	-	-	-	-	2	2	2

COURSE CONTENT	
UNIT I	**Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.
UNIT II	**Tools and Methods:** Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.
UNIT III	**Cyber Crime Investigation:** Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.
UNIT IV	**Computer Forensics and Investigations:** Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics

	Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.
UNIT V	**Cyber Crime Legal Perspectives:** Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act-ITA2000, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime andPunishment, Cyberlaw, Technology and Students: Indian Scenario.

TEXT BOOKS	
1.	Sunit Belapure Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY,First Edition 2011.
2.	Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
REFERENCE BOOKS	
1.	Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hacking and Network Defence", Cengage, 2019.
2.	Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi,First Edition,2015
3.	Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar "Cyber Security and Cyber Laws" , Cengage,First Edition,2018.
WEB RESOURCES	
1.	CERT-In Guidelines- http://www.cert-in.org.in/
2.	https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks [Online Course]
3.	https://computersecurity.stanford.edu/free-online-videos [Free Online Videos]
4.	Nickolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu License: Creative Commons BY-NC-SA.

III Year II Semester
HEAT TRANSFER LABORATORY

Course Category	Professional Core	**Course Code**	20ME6L12
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Heat Transfer	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	The practical exposure with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for different geometries.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Perform steady state conduction experiments to estimate thermal conductivity & Overall heat transfer coefficient of different materials.	K2
CO2	Estimate Heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values	K2
CO3	Perform Radiation experiments: Determine Surface emissivity of a test plate and verification of Stefan-Boltzman constant and determine thermal properties and performance of Heat exchanger.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO2	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO3	2	1	2	2	-	-	-	-	-	-	-	-	2	1

LIST OF EXPERIMENTS

1. Determination of overall heat transfer co-efficient of a composite slab
2. Determination of heat transfer rate through a lagged pipe
3. Determination of thermal conductivity of a metal rod.
4. Determination of efficiency of a pin-fin.
5. Determination of heat transfer coefficient in natural convection.
6. Determination of heat transfer coefficient forced convection.
7. Determination of effectiveness of parallel flow heat exchangers.
8. Determination of effectiveness of counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzmann constant.
11. Determination of heat transfer rate in drop wise condensation.
12. Determination of heat transfer rate in film wise condensation.
13. Determination of critical heat flux.
14. Analyze the performance of heat pipe with two geometrical similar pipes of copper and stainless steel.

Note: At least 10 experiments to be conducted.

III Year II Semester
METROLOGY AND INSTRUMENTATION LABORATORY

Course Category	Professional Core	**Course Code**	20ME6L13
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	For measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness	K3
CO2	Demonstrate the measure of angle by sine bar and universal bevel protractor	K3
CO3	Demonstrate the use of instruments of measuring pressure, flow, speed, displacement, temperature	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	-	-	2	-	-	-	3	-	2	3	3
CO2	2	3	3	-	-	2	-	-	-	3	-	2	3	3
CO3	3	3	3	-	-	2	-	-	-	3	-	2	3	3

COURSE CONTENT

1. Measurements of lengths, heights, diameters by Vernier callipers.
2. Measurement of bores by dial bore indicators.
3. Use of gear tooth callipers for tooth thickness inspection and flange Micrometer for checking the chordal thickness of spur gear.
4. Angle measurements and tape measurements with bevel protractor.
5. Angle measurements and tape measurements with sine bars.
6. Measurement of the specimen by Screw gauge.
7. Study and calibration of LVDT transducer for displacement measurement.
8. Study and calibration of Rotameter.
9. Study and calibration of speed measurement.
10. Study and calibration of capacitive transducer.
11. Study and calibration of RTD
12. Study and calibration of MCLEOD GAUGE.
13. Study and calibration of Dead weight pressure gauge

Note: At least 10 experiments to be conducted.

III Year II Semester
CAE AND CAM LABORATORY

Course Category	Professional Core	**Course Code**	20ME6L14
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE OBJECTIVES	
1	To learn the basic element types in Finite Element Analysis.
2	To utilize the concept of ANSYS-FLUENT to acquire results.
3	To impart knowledge on G-codes and M-codes for develop a CNC Turning programming and to know various tools to be used to manufacture the products in industries.
4	To impart knowledge on G-codes and M-codes for develop a CNC Milling programming and to know various tools to be used to manufacture the products in industries.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Simulate steady state heat transfer analysis, nonlinear analysis, buckling analysis and flow analysis.	K3
CO2	Evaluate the matrices of beam/in-plane/solid elements using MATLAB Software.	K3
CO3	Develop CNC program for real-time product manufacturing applications in CNC lathe machine	K3
CO4	Develop CNC program for real-time product manufacturing applications in CNC milling machine	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	3	-	-	-	-	-	-	-	3	-
CO3	1	2	3	2	3	-	-	-	1	-	-	1	2	3
CO4	1	2	3	2	3	-	-	-	1	-	-	1	2	3

LIST OF EXPERIMENTS

CAE LAB

1. Determination of deflection and stresses in 2D and 3D beams.
2. Analysis of Plane Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static, thermal and combined loading.
3. Plane stress, plane strain and axisymmetric loading on the in-plane members with in-plane loading to study the stresses and strains
4. Determination of stresses in 3D and shell structures (at least one example in each case)
5. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
6. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
7. Steady state heat transfer Analysis of plane and Axisymmetric components.
8. Nonlinear analysis of cantilever beam with non-linear materials at tip moment and post Buckling analysis of shells for critical loads.
9. Flow analysis of pipe with different fluids/gasses/air for velocity and pressure gradients.
10. CFD analysis of aerofoil design

11. CFD analysis of ducts/impeller/fan
12. Use of MATLAB for finding B matrix, stiffness matrix and loading matrices of beam/in-plane/solid elements and interfacing with CAE software's.

Note: Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA may be used. Total 6 experiments to be conducted from the above.

CAM LAB

Practices on CNC Turning Machine

1. Programming for facing operation.
2. Programming for turning operation.
3. Programming for Linear and Circular interpolation.
4. Programming for Facing Cycle.
5. Programming for Multiple Facing Cycle.
6. Programming for Grooving Cycle.

Practice on CNC Milling Machine

1. Programming using linear and circular interpolation.
2. Programming using Sub-Program.
3. Programming for Mirroring Operation.
4. Programming for Circular Pocket Milling operation.
5. Programming for Rectangular Pocket milling operation.
6. Programming for Drilling Operation

Total 6 experiments to be conducted from the above.

III B Tech II Semester
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY

Course Category	Skill Oriented	**Course Code**	20AM6SO2
Course Type	Laboratory	**L-T-P-C**	1-0-2-2
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	00 50 50

COURSE OBJECTIVES	
The student will:	
1	This course will enable students to learn and understand different Data sets in implementingthe machine learning algorithms.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Implement procedures for the machine learning algorithms.	K1
CO2	Design and Develop Python programs for various Learning algorithms	K2
CO3	Apply appropriate data sets to the Machine Learning algorithms	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	--	--	--	--	--	--	--	--	2	2	2
CO2	3	2	1	--	--	--	--	--	--	--	--	1	1	1
CO3	3	2	1	--	--	--	--	--	--	--	--	--	1	1

Requirements: Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

List of Experiments	
Artificial Intelligence Programs	
1	Implementation of DFS for water jug problem using LISP/PROLOG
2	Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java.
3	Implementation of TSP using heuristic approach using Java/LISP/ PROLOG.
4	Implementation of TSP using heuristic approach using Java/LISP/ PROLOG.
5	Implementation of Hill-climbing to solve 8- Puzzle Problem.
Machine Learning Programs	
6	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
7	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
8	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
9	Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier
10	Develop a program for Bias, Variance, Remove duplicates, Cross Validation

III Year II Semester
RESEARCH METHODOLOGY

Course Category	Mandatory	**Course Code**	20HM6T10
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand some basic concepts of research and its methodologies and develop the basic framework of research process	K2
CO2	Identify research problem and identify various sources of information for literature review	K4
CO3	Understand the concept of Research Design and develop a proper research plan	K2
CO4	Identify various sources of information for Data collection and understand and apply statistical techniques for better decision making	K3
CO5	Formulate Research Report and Research proposal to solve a particular problem.	K5

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	2	-	1	-	2	-	-
CO2	-	-	-	-	-	1	-	2	1	1	-	1	-	-
CO3	-	-	-	-	-	1	-	1	1	1	-	-	-	-
CO4	-	-	-	-	-	1	-	1	1	1	-	-	-	-
CO5	-	-	-	-	-	1	1	1	1	1	-	2	-	-

COURSE CONTENT

UNIT I
Introduction: Nature and Importance of Research, Aims of social research, Types of Research, Research Approaches, Ethical issues in Research, Research Methods verses Methodology, Criteria of Good Research, Steps in Research process.

UNIT II
Defining the Research Problem and Literature survey: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem, Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT III
Research Design: Meaning of Research Design, Need of Research Design, Important concepts related to Design, Different Research Designs Selection of an appropriate survey Research Design, the nature of field work and Field work management Self-administered Questionnaires, Developing a Research Plan.

UNIT IV
Data collection and statistical Inference: Collection of Primary Data, Secondary Data, Methods of Data

Collection, Need for Sampling, Sampling Design, Formulation of Hypothesis –Tests of Hypothesis - Introduction to Null hypothesis vs. Alternative Hypothesis, Parametric vs. Non-Parametric Tests, Procedure for testing of Hypothesis, Tests of significance for Small Samples, Application, t-test, Chi Square test

UNIT V

Research Report Writing and Research Proposal: Format of the Research report, References/Bibliography, Technical paper writing, Journal Report Writing, Making Presentation, writing a Research Proposal and Research Report, Writing Research Grant Proposal.

REFERENCE BOOKS

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers.
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi.
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi.
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad.
7. Naval Bajjai “Business Research Methods” Pearson.

WEB RESOURCES

1. https://www.indeed.com/career-advice/career-development/research-design
2. https://online.hbs.edu/blog/post/data-collection-methods
3. https://imotions.com/blog/statistical-tools/

IV Year I Semester
POWER PLANT ENGINEERING

Course Category	Professional Elective	**Course Code**	20ME7T26
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	IC Engines and Turbo Machinery, Fluid Mechanics and Hydraulic Machines	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Student can learn about power generation through prime movers by using steam.
2	Student can learn about power generation through prime movers by using Diesel and Gas energy.
3	Student can learn about power generation through prime movers by using hydro power and non-conventional energy such as solar, wind and tidal.
4	Student can able to understand the power generation through Nuclear Reactors.
5	Student can able to understood the importance of economic and environmental considerations of power plants.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the functions of the different components of steam power plant.	K2
CO2	Illustrate the working of Diesel and Gas power plant.	K3
CO3	Demonstrate the working of hydel power plant and non-conventional energy generation	K3
CO4	Classify different reactors for power generation and explain the working of nuclear plants	K3
CO5	Estimate various costs related to the economics of power plants.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	2	2	-
CO5	2	2	-	3	3	2	3	3	3	-	2	3	2	3

COURSE CONTENT

UNIT I
STEAM POWER PLANT

Introduction to the Sources of Energy – Resources and Development of Power in India. Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipment's, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

COMBUSTION PROCESS: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT II

INTERNAL COMBUSTION ENGINE PLANT

DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

GAS TURBINE PLANT: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT III

HYDRO ELECTRIC POWER PLANT

Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

HYDRO PROJECTS AND PLANT: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar energy, Fuel cells, Thermo-electric and Thermo-ionic, MHD generation - Collectors Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

UNIT IV

NUCLEAR POWER STATION

Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT V

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor– related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS

1. Power Plant Engineering – P.C.Sharma / S.K.Kataria Publications.
2. A Course in Power Plant Engineering: / Arora and S. Domkundwar.

REFERENCE BOOKS

1. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications.
2. Power plant Engineering/ Ramalingam/ Scietech Publishers.
3. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
4. An Introduction to Power Plant Technology / G.D. Rai.
5. Power plant Engg - Elanchezhian- I.K. International Publications.

WEB RESOURCES

1. http://nptel.ac.in/courses/112106133/1
2. http://nptel.ac.in/courses/112106133/2
3. http://nptel.ac.in/courses/112106133/3
4. http://nptel.ac.in/courses/112106133/4

IV Year I Semester
FINITE ELEMENT METHODS

Course Category	Professional Elective	**Course Code**	20ME7T27
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Basics of Mathematics, Mechanics of Solid, Dynamics of Machinery, Heat Transfer	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn basic principles of finite element analysis procedure, Concept of discretization and characteristics of finite elements that represent engineering structures.
2	To learn the theory and characteristics of finite elements that represent engineering structures-Trusses and Beams
3	To learn and apply finite element solutions to structural, thermal and dynamic problems.
4	Learn to model complex geometry problems and solution techniques.
5	To solve heat transfer and other field problems using FEM and FE procedure for dynamic analysis of structures.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the concepts behind variational methods and weighted residual methods in FEM	K2
CO2	Identify the application and characteristics of FEA elements such as trusses, beams.	K3
CO3	Identify the application and characteristics of FEA elements such as constant strain triangles and iso-parametric elements, and axisymmetric problems.	K3
CO4	Apply Suitable boundary conditions to global equations, and reduce it to a solvable form.	K3
CO5	Apply the FE procedure to field problems like heat transfer.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2	-	-	-	2	-	-	2	2	-
CO2	3	2	3	1	3	-	-	-	2	-	-	2	2	-
CO3	3	2	3	2	1	-	-	-	2	-	-	2	2	-
CO4	3	2	2	1	1	-	-	-	2	-	-	2	1	-
CO5	3	2	2	3	1	-	-	-	2	-	-	2	2	-

COURSE CONTENT

UNIT I

Introduction: basic concepts, historical back ground, applications of FEM, general description, Comparison of FEM with other methods**,** stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential energy, and one-dimensional problems.

Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, and mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.

UNIT II

Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT IV

Higher order and iso-parametric elements: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded iso-parametric elements and numerical integration.

UNIT V

Steady state heat transfer analysis: one dimensional analysis of a fin and two-dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion.

Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.

TEXT BOOKS

1. Introduction to Finite Elements in Engineering/ Tirupathi R. Chandrupatla, Ashok D. Belegundu, Pearson Publishers.
2. The Finite Element Methods in Engineering / SS Rao / Pergamon.

REFERENCE BOOKS

1. Finite Element Method with applications in Engineering / YM Desai, Eldho & Shah /Pearson publishers.
2. An introduction to Finite Element Method / JN Reddy / McGraw Hill.
3. Finite Element Methods Basic Concepts and Applications/ Chennakesava R.Alavala PHI Learning Private Limited.
4. Fundamentals of Finite Element Analysis/ David V.Hutton/ Mc Graw Hill Education.
5. A first Course in the Finite Element Method/Daryl L. Logan/ Cengace Learning.
6. Finite Element Analysis Theory and Application with ANSYS/Saeed Moaveni/Pearson

WEB RESOURCES

1. https://nptel.ac.in/courses/112/104/112104115/
2. https://nptel.ac.in/courses/112/104/112104193/
3. https://nptel.ac.in/courses/112/104/112104205/
4. https://nptel.ac.in/courses/105/106/105106051/
5. https://nptel.ac.in/courses/105/105/105105041/

IV Year I Semester
ADDITIVE MANUFACTURING

Course Category	Professional Elective	**Course Code**	20ME7T28
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Production Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
Students will learn	
1	Fundamentals of rapid prototyping and concepts of liquid-based rapid prototyping systems
2	Concepts of solid-based rapid prototyping systems
3	Concepts of powder-based rapid prototyping systems
4	Different rapid tooling processes
5	Rapid prototyping data formats and applications of additive manufacturing in various industries

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the rapid prototyping fundamentals & choose different liquid based rapid prototyping processes for manufacturing	K2
CO2	Choose different solid based rapid prototyping processes for manufacturing	K2
CO3	Choose different powder based rapid prototyping processes for manufacturing	K2
CO4	Choose different rapid tooling processes for prototyping manufacturing	K2
CO5	Elaborate the uses of additive manufacturing processes in various industries.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO2	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1	-
CO5	1	-	-	-	1	-	-	-	-	-	-	-	1	-

COURSE CONTENT

UNIT I

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Photopolymers, photo polymerization, layering technology, laser and laser scanning. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications,

advantages and disadvantages, case studies.

UNIT III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three-dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies

UNIT IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT V

ENHANCING ADDITIVE MANUFACTURING WITH REVERSE ENGINEERING: Reverse engineering, uses of reverse engineering, Steps for reverse engineering in additive manufacturing, 3D scanning techniques.

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis.

TEXT BOOKS

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003

REFERENCE BOOKS

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

WEB RESOURCES

1. nptel.ac.in/courses/112104204/47
2. nptel.ac.in/courses/112107078/37
3. https://www.youtube.com/watch?v=kNz-TM4zPkE&list=PLbTLRuAivTCR0YVCNxSTPI9lgccanmZLG
4. https://lecturenotes.in/m/46059-note-of-additive-manufacturing-by-madhura-diwakar?reading=true
5. https://www.slideshare.net/badebhau/additive-manufacturing-processes-pdf-by-badebhau4gmailcom

IV Year I Semester
OPTIMIZATION TECHNIQUES

Course Category	Professional Elective	**Course Code**	20ME7T29
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Operations Research	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
To make the students learn about	
1	Classical optimization techniques
2	Numerical methods for optimization
3	Genetic algorithm and Genetic programming
4	Multi-Objective Genetic algorithm
5	Optimization in design and manufacturing systems

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze the Classical optimization techniques for single and multi-variable problems with and with and without constraints.	K4
CO2	Apply numerical methods for optimization of manufacturing related problems	K3
CO3	Apply the Principles of genetic algorithm and genetic programming to manufacturing related problems	K3
CO4	Analyze the Multi-Objective Genetic algorithm for industrial problems	K4
CO5	Solve engineering problems by using optimization techniques in design and manufacturing systems	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	2	2	1	-	-	-	-	-	-	-	2	1
CO2	2	3	2	2	1	-	-	-	-	-	-	1	2	1
CO3	2	3	2	2	1	-	-	-	-	-	-	1	2	1
CO4	2	3	2	2	1	-	-	-	-	-	-	1	2	1
CO5	2	3	2	2	1	-	-	-	-	-	-	1	2	1

COURSE CONTENT

UNIT I

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions, merits and demerits of classical optimization techniques.

UNIT II

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead’s Simplex search method, Gradient of a function, Steepest descent method, Newton’s method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

UNIT III

GENETIC ALGORITHM (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT IV

MULTI-OBJECTIVE GA: Pareto's analysis, non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNIT V

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS

1. Engineering Optimization Theory & Practice, Singiresu S. Rao New Age International Publishers, Ltd.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI Publishers.

REFERENCE BOOKS

1. Genetic algorithms in Search, Optimization, and Machine learning, D.E.Goldberg, Addison-Wesley Publishers
2. Multi objective Genetic algorithms, Kalyanmoy Deb, PHI Publishers
3. Optimal design, Jasbir Arora, Mc Graw Hill (International) Publishers
4. Optimum Design of Mechanical Elements, Ray C. Johnson, John Wiley & sons, Inc., New York.

WEB RESOURCES

1. https://nptel.ac.in/courses/111/105/111105039/
2. https://nptel.ac.in/courses/106/108/106108056/
3. https://nptel.ac.in/courses/112/105/112105235/
4. https://onlinecourses.nptel.ac.in/noc21_me43/preview
5. https://www.nptel.ac.in/content/syllabus_pdf/112103301.pdf

IV Year I Semester

REFRIGERATION AND AIR CONDITIONING

(Refrigeration and Psychrometric tables and charts allowed)

Course Category	Professional Elective	**Course Code**	20ME7T30
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To impart basic knowledge of refrigeration, study air refrigeration cycles and aircraft refrigeration.
2	To make students aware of vapour compression systems and usage of p-h charts.
3	To study various components used in VCR systems and types of refrigerants.
4	To make students aware of vapour absorption system and Steam jet refrigeration system.
5	To impart knowledge of psychrometric properties, processes used in air-conditioning.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the importance of different refrigeration systems and air refrigeration systems in aircrafts.	K2
CO2	Analyze vapour compression refrigeration cycle and identify influence of various parameters on system performance	K4
CO3	Explain about different components and refrigerants used in vapour compression refrigeration system.	K2
CO4	Explain about vapour absorption system and steam jet refrigeration systems	K2
CO5	Perform cooling load calculations and select the appropriate process equipment for air-conditioning.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	2	-	-	-	-	-	-	-	1	1
CO2	2	-	1	2	1	-	-	-	-	-	-	-	2	-
CO3	3	1	-	-	1	-	-	-	-	-	-	-	1	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO5	2	1	1	2	3	-	-	-	-	-	-	-	1	2

COURSE CONTENT

UNIT I

INTRODUCTION TO REFRIGERATION: Necessity and applications - unit of refrigeration and COP.

REFRIGERATION: Mechanical refrigeration - types of ideal cycles of refrigeration, air refrigeration: bell-coleman cycle - open and dense air systems - refrigeration systems used in aircrafts and problems.

UNIT II

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle and essential components of the plant - simple vapour compression refrigeration cycle - COP - representation of cycle

on T-S and p-h charts - effect of sub cooling and super heating - cycle analysis - actual cycle influence of various parameters on system performance - use of p-h charts - numerical problems.

UNIT III

REFRIGERANTS: Desirable properties – classification - refrigerants used - nomenclature – ozone depletion – global warming.

VCR SYSTEM COMPONENTS: Compressors – general classification –comparison – advantages and disadvantages. condensers – classification – working principles evaporators – classification – working principles, expansion devices – types – working principles.

UNIT IV

VAPOUR ABSORPTION SYSTEM: Calculation of maximum COP–description and working of NH3 – water system and Li Br –water (Two shell & Four shell) System, principle of operation three fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components.

NONCONVENTIONAL REFRIGERATION METHODS: Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube

UNIT V

INTRODUCTION TO AIR CONDITIONING: Psychometric properties &processes – characterization of sensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF-problems, concept of ESHF and ADP temperature, air conditioning load calculations.

TEXT BOOKS

1. Refrigeration and air conditioning, C.P. Arora., Tata McGraw-Hill Education.
2. A Course in Refrigeration and Air conditioning, Domkundwar, S.C. Arora, Dhanpatrai Publications, New Delhi, India.

DATA BOOKS

1. Refrigeration and Air Conditioning Data book, S. Domakundwar, Dhanpathi rai & CO.
2. Refrigeration and Air Conditioning Data book, CP Kothandaraman, New age publishers.

REFERENCE BOOKS

1. Refrigeration and Air conditioning, Manohar Prasad, New Age international.
2. Refrigeration and Air Conditioning, R K Rajput, S K kataria & sons.
3. Principles of Refrigeration, Roy J. Dossat · Thomas J. Horan, Pearson Education India.
4. Refrigeration and Air conditioning, R. S. Khurmi, J. K. Gupta, S. Chand.

WEB RESOURCES

1. http://nptel.ac.in/courses/112106133/23
2. http://nptel.ac.in/courses/112106133/28
3. http://nptel.ac.in/courses/112106133/30
4. http://nptel.ac.in/courses/112106133/31
5. http://nptel.ac.in/courses/112106133/32

IV Year I Semester
CONDITION MONITORING

Course Category	Professional Elective	**Course Code**	20ME7T31
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Basics of Vibration in conditional monitoring.
2	Techniques of vibration measurement and analysis.
3	Fault diagnosis and some case studies for interpreting vibration measurement.
4	Thermography and its applications in conditional monitoring
5	Oil and wear debris analysis and its properties.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the concepts of Vibration, SDOF and MDOF systems.	K2
CO2	Analyze the vibrations using various techniques.	K3
CO3	Interpret various faults in vibrations for diagnosis.	K3
CO4	Inspect the equipment using thermography	K3
CO5	Analyze various properties of oil and wear particles by condition monitoring	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	-	-	1	-	-	-	-	2	1
CO2	3	3	2	1	-	2	2	-	-	-	-	-	1	1
CO3	2	2	1	1	1	2	2	-	-	-	-	-	1	1
CO4	3	3	3	2	-	3	3	-	-	-	-	2	2	1
CO5	3	2	2	2	-	1	1	-	-	-	-	-	1	1

COURSE CONTENT

UNIT I

BASICS OF VIBRATION: Basic motion: amplitudes, period, frequency, basic parameters: displacement, velocity, acceleration, units (including dB scales) and conversions, Mass, spring and damper concept, Introduction to SDOF and MDOF systems, Natural frequencies and resonance, Forced response.

UNIT II

VIBRATION MEASUREMENTS AND ANALYSIS: Transducers and mounting methods, data acquisition using instrumentation recorders/data loggers, time domain signal analysis, orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, Sampling, aliasing, windowing and averaging.

UNIT III

Fault Diagnosis, Interpreting vibration measurements for common machine faults, imbalance,

misalignment, mechanical looseness, bearing and gearing faults, faults in induction motors, resonances, some case studies, static and dynamic balancing, international standards for vibration condition monitoring.

UNIT IV

THERMOGRAPHY: The basics of infrared thermography, differences in equipment and specific wave length limitations, application of ir to: electrical inspection, mechanical inspection, energy conservation, how to take good thermal images, hands-on demonstrations focusing on proper camera settings and image interpretation, analysis of thermal images and report generation, study of thermography applications

UNIT V

OIL AND WEAR DEBRIS ANALYSIS: Basics of oil analysis, monitoring condition of oil, lubricant analysis, physio – chemical properties, moisture, tan tbn, wear debris analysis, particle counting, spectroscopy, uses & limitations, ferrography wear particle analysis, concept of ferrography, principle particle classification, size, shape, composition, concentration, analysis procedure, sampling & analytical ferrography equipment, severity rating.

TEXT BOOKS

1. The Vibration Analysis Handbook, J I Taylor (1994).
2. Machinery Vibration Condition Monitoring, Lynn, Butterworth(1989).

REFERENCE BOOKS

1. Machinery Vibration: Measurement and Analysis. Victor Wowk (1991).
2. Mechanical fault diagnosis and condition monitoring, RA Collacott (1977).
3. The Vibration Monitoring Handbook (Coxmoor's Machine & Systems Condition Monitoring) (1998).
4. Condition monitoring of machinery by J.S.Rao, Narosa publishers,2013.

WEB RESOURCES

1. http://nptel.ac.in/courses/112103112/40

IV Year I Semester
DESIGN FOR MANUFACTURING

Course Category	Professional Elective	**Course Code**	20ME7T32
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Material Science and Metallurgy, Production Technology, Metrology	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To familiarize with the design considerations for manufacturing and assembly.
2	To discusses capabilities and limitations of each manufacturing process in relation to part design and cost
3	To learn how to analyze products and be able to improve their manufacturability and lower costs.
4	To understand the relationship between customer desires, functional requirements, product materials, product design, and manufacturing process selection.
5	To understand the concepts of extrusion and plastic components design process.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply the principles of design for manufacturing processes.	K3
CO2	Understand the design rules for machining and its recommendations.	K2
CO3	Analyze the metal casting processes and its simulation system in casting design.	K4
CO4	Identify the design factors for casting welding and forging.	K3
CO5	Understand the design guidelines for extrusion, sheet metal and non-metallic components.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	1	3	2	-	-	-	-	-	-	-	-	2	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	1	2	1	1	-	-	-	-	-	-	-	2	-
CO4	2	1	1	2	1	-	-	-	-	-	-	-	2	-
CO5	-	-	1	1	-	-	-	-	-	-	-	-	2	-

COURSE CONTENT

UNIT I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design. Design for the life cycle total product life consumer goods –design considerations, Effect of manufacturing process on design, mechanisms selection, and evaluation method.

Materials: Relation of Material selection to design and process, Process selection.

UNIT II

Machining processes: Overview of various machining processes-general design rules for machining-

dimensional tolerance and surface roughness-Design for machining-ease-redesigning of components for machining ease with suitable examples, General design recommendations for machined parts, Design for economy - Design for accessibility.

UNIT III

Metal casting: Appraisal of various casting processes, selection of casting process, -general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting. Design for assembly method- Dewhurst DFA method, Material selection process and economics of materials.

UNIT IV

Metal joining: Appraisal of various welding processes factors in design of weldments– general design guidelines pre- and post-treatment of welds- effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging– closed die forging design– parting lines of dies– drop forging die design– general design recommendations.

UNIT V

Extrusion & Sheet metal work: Design guide lines extruded sections- design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram– component design for blanking.

Non-Metallic Components Design: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding–design guidelines for machining and joining of plastics.

TEXT BOOKS

1. Design for Manufacture by Boothroyd Dewhurst.
2. Design for manufacture byJames Bralla.
3. Engineering Design - George E Dieter.

REFERENCE BOOKS

1. O. Molloy, “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Chapman and Hall, 1st Edition.
2. Robert Matousek., Engineering Design - A Systematic Approach, Blackie & Sons Ltd, 1963.
3. Swift, K. G., Knowledge Based Design for Manufacture, Kogan Page Ltd., 1987

WEB RESOURCES

1. http://www.npd-solutions.com
2. ASM HandbookVol.20
3. http://nptel.ac.in/courses/112101005/
4. http://nptel.ac.in/syllabus/syllabus_pdf/112101005.pdf
5. http://nptel.ac.in/courses/107103012/6
6. http://nptel.ac.in/syllabus/112101005/

IV Year I Semester
CAD/CAM

Course Category	Professional Elective	**Course Code**	20ME7T33
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Production Technology, Metal cutting and Machine Tools	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Understand various modules of CAD & CAM and apply the concepts for geometry transformation techniques digitally.
2	Create and manipulate the different geometric modelling techniques.
3	Understand various concepts of part programming for NC and CNC Elements
4	Demonstrate the concepts of GT, CAPP and FMS
5	Able to understand various quality control and testing techniques using computers, and their integration to manufacturing.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate various geometrical transformation techniques and understand the working of various CAD and CAM elements.	K2
CO2	Demonstrate the different representations in the geometric modules	K2
CO3	Apply the concepts of NC and CNC Programming and write program for NC/CNC turning and machining centers.	K3
CO4	Distinguish various grouping concepts and summarize the use of computers in manufacturing and the manufacturing process planning.	K2
CO5	Identify the advantages and disadvantages in integrating computers in quality control, testing and manufacturing.	K1

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	3	-	2	-	-	-	-	-	-	-	2	-
CO2	1	1	3	-	3	1	-	-	-	3	1	-	2	-
CO3	2	3	3	2	2	2	-	-	-	-	2	1	1	-
CO4	-	3	2	-	2	1	-	-	-	-	2	1	1	-
CO5	3	3	2	3	1	-	-	-	-	2	-	1	2	-

COURSE CONTENT

UNIT I

Fundamentals of CAD: computers in industrial manufacturing, product cycle, cad / cam hardware, basic structure of CAD/CAM systems-input devices, CPU and output devices.

Computer Graphics: Working of a CRT display device-random scan and raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping-cohen sutherland clipping algorithm, hidden surface removal.

UNIT II

Geometric Modeling: Requirements, geometric models, geometric construction models, Curve representation methods, surface representation methods, modeling facilities desired. Solid modeling – solid representation, boundary representation and constructive solid geometry

UNIT III

Part Programming for NC Machines: NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, Turning center,

Part Programming for CNC Machines: Fundamentals, manual part programming methods, computer aided part programming. Direct numerical control, adaptive control.

UNIT IV

Group Technology (GT): Part family, coding and classification, production flow analysis, types and advantages.

Computer aided processes planning (CAPP): Importance, types-retrieval type CAPP system, generative type CAPP system and hybrid CAPP System, benefits of CAPP.

Flexible Manufacturing Systems (FMS): Introduction, Equipment, Tool Management Systems, Layouts, FMS control.

UNIT V

Computer Aided Quality Control: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, Computer Aided Testing (CAT), integration of CAQC with CAD/CAM.

Computer Integrated Manufacturing Systems: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems,

TEXT BOOKS

1. CAD / CAM / CAE E Zimmers & M.Groover/Pearson Education.
2. Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E.
3. Principles and applications of CAD/CAM by J.Srinivas, Oxford University Press, N.D, 2017.

REFERENCE BOOKS

1. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH.
2. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson.
3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.
4. Product manufacturing and cost estimation using CAD/CAE/ Kuang Hua Chang, Elsevier Publishers.
5. CAD/CAM/CIM by P. Radhakrishnan, S.Subramanyan, V.Raju, New age Publications.

WEB RESOURCES

1. http://nptel.ac.in/courses/112102101/

IV Year I Semester
GAS DYNAMICS & JET PROPULSION

Course Category	Professional Elective	**Course Code**	20ME7T34
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Heat Transfer	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Basic concept of gas dynamics
2	The Isentropic flow fundamentals
3	The compressible flow with friction and heat transfer
4	The effect of heat transfer on flow parameters.
5	The usage in jet air craft & aircraft propulsion systems and rocket propulsion and its applications.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain basic concepts of gas dynamics.	K2
CO2	Apply the steady one-dimensional isentropic flow.	K3
CO3	Apply the flow properties in an isothermal flow with friction.	K3
CO4	Explain the effect of heat transfer on flow parameters.	K2
CO5	Discuss propulsion in various aircrafts & rockets.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	1	2	1	-	-	-	-	-	1	1	1
CO2	2	-	3	1	2	-	-	-	-	-	-	-	2	-
CO3	3	2	3	2	1	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	1	-	-	-	-	-	-	-	2	1
CO5	2	1	3	2	3	-	-	-	-	-	-	-	1	2

COURSE CONTENT

UNIT I

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone- compressibility factor - general features of one-dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT II

Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one-dimensional isentropic flow with area change-effect of area changes on flow parameters- chocking-convergent nozzle - performance of a nozzle under decreasing back pressure -De level nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients – nozzle efficiencies.

UNIT III

Simple frictional flow: adiabatic flow with friction in a constant area duct governing equation - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct governing equations - limiting conditions. Steady one-dimensional flow with heat transfer in constant area ducts governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT IV

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT V

Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance.

TEXT BOOKS

1. Fundamentals of compressible flow with aircraft and rocket propulsion- S. M.Yahya
2. Compressible fluid flow - A. H.Shapiro.
3. Fundamental of Gas dynamics, 2nd edition– Zucker- Wileypublishers.

DATA BOOK:

1. Compressible flow gas tables S. M. Yahya, New age international publications.

REFERENCE BOOKS

1. Elements of gas dynamics – Liepman & Roshko.
2. Aircraft & Missile propulsion -Zucrow.
3. Gas dynamics - M.J. Zucrow& JoeD.Holfman.

WEB RESOURCES

1. https://nptel.ac.in/courses/101/106/101106044/
2. https://nptel.ac.in/courses/112/106/112106166/

IV Year I Semester
UNCONVENTIONAL MACHINING PROCESSES

Course Category	Professional Elective	**Course Code**	20ME7T35
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Production Technology, Metal cutting and Machine tools	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Understand the Need of unconventional machining processes and working of USM
2	Learn the working of electro chemical machining
3	Study the working of Thermal Metal Removal Processes
4	Learn the working of Electron Beam Machining, Laser Beam Machining
5	Understand the working of Abrasive jet machining, Water jet machining and abrasive water jet machining

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain unconventional machining processes and working of USM	K2
CO2	Explain the electro chemical machining processes	K2
CO3	Classify the operations performed in Thermal metal removal processes	K2
CO4	Recall operation of Electron Beam Machining, Laser Beam Machining	K1
CO5	Explain the processes of Abrasive jet machining, Water jet machining and abrasive water jet machining	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	-	1	-	-	-	2	-	-	-	-	1	1	-
CO3	2	-	1	-	-	-	-	-	-	-	-	1	3	-
CO4	2	-	-	-	-	-	-	-	-	-	-	1	3	-
CO5	2	-	-	-	-	-	2	-	-	-	-	1	2	-

COURSE CONTENT

UNIT I

INTRODUCTION: Need for non-traditional machining methods-classification of modern machining process – considerations in process selection, applications. Ultrasonic machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.

UNIT II

ELECTRO – CHEMICAL MACHINING: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and de-burring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical machining, advantages and applications.

UNIT III

THERMAL METAL REMOVAL PROCESSES: General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface.

UNIT IV

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications Plasma Machining: Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT V

Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipment, process variables, mechanics of material removal, MRR, application and limitations, magnetic abrasive finishing, abrasive flow finishing, Electro stream drilling, shaped tube electrolytic machining.

TEXT BOOKS

1. Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel –Gawad El-Hafy/CRC Press-2016.
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH.

REFERENCE BOOKS

1. New Technology / Bhattacharya A/ the Institution of Engineers, India 1984.
2. Non-Traditional Manufacturing Processes / Benedict

WEB RESOURCES

1. https://nptel.ac.in/courses/112/104/112104028/
2. https://nptel.ac.in/courses/112/103/112103202/

IV Year I Semester
NON-DESTRUCTIVE EVALUATION

Course Category	Professional Elective	**Course Code**	20ME7T36
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Physics, Material Science and Metallurgy	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To provide a basic understanding for inspecting materials in accordance with industry specifications and standards.
2	To introduce students to a variety of practical applications associated with ultrasonic testing
3	They will learn basic principles of NDE methods and will able to select a testing process
4	They will learn the magnetic particle testing techniques and their fundamental concepts
5	Be able to explain the purpose of the Equipment, Application, and standard techniques required to perform major non-destructive and destructive examinations of welds

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the Radiography testing	K2
CO2	Apply the knowledge of Ultrasonic testing	K3
CO3	Understand the Liquid penetrant and Eddy Current Testing	K2
CO4	Analyze the magnetic particle testing techniques and their fundamental concepts	K4
CO5	Differentiate various defect types and select the appropriate NDT methods for better evaluation.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	1	-	2	-	-	-	-	-	-	-	-	2
CO2	2	-	1	-	3	-	-	-	-	-	-	-	-	2
CO3	2	-	2	-	3	-	-	-	1	-	-	-	1	2
CO4	2	-	1	-	2	-	-	-	1	-	-	-	1	2
CO5	2	2	2	-	3	-	-	-	1	-	-	-	1	2

COURSE CONTENT

UNIT I

Introduction to non-destructive testing: Visual inspection. radiography: sources of x - ray & gamma-ray production - properties of gamma and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

UNIT II

Ultrasonic test: Reflection, refraction, diffraction, mode conversion and attenuation, sound field, piezo-electric effect. production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method –A, B, C scans - principles of acoustic emission techniques - advantages and limitations - instrumentation - applications. ultrasonic transducers and their characteristics.

UNIT III

Liquid Penetrant Test: Liquid penetrant test, basic concepts, liquid penetrant system, test procedure, effectiveness and limitations of liquid penetrant testing.

Eddy Current Test: Principle of eddy current, eddy current test system, applications of eddy current testing effectiveness of eddy current testing.

UNIT IV

Magnetic Particle Test: Magnetic materials, magnetization of materials, demagnetization of materials, principle of magnetic particle test, magnetic particle test equipment, magnetic particle test procedure, standardization and calibration, interpretation and evaluation, effective applications and limitations of the magnetic particle test.

UNIT V

Thermography: Thermography principles, types, applications, advantages and limitations. case studies: weld, cast and formed components**.**

Industrial Applications of NDE: Span of NDE activities railways, nuclear, non-nuclear and chemical industries, aircraft and aerospace industries, automotive industries, offshore gas and petroleum projects, coal mining industry, NDE of pressure vessels, castings, welded constructions.

TEXT BOOKS

1. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
2. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989).

REFERENCE BOOKS

1. Non-destructive, Hand Book – R. Hamchand.
2. Ultrasonic inspection training for NDT/ E. A. Gingel/Prometheus Press.

WEB RESOURCES

1. https://archive.org/details/nondestructivete000538mbp
2. http://www.issp.ac.ru/ebooks/books/open/Nondestructive_Testing_Methods_and_New_Applications.pdf

IV Year I Semester
PRODUCTION PLANNING AND CONTROL

Course Category	Professional Elective	**Course Code**	20ME7T37
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Industrial Engineering and Management	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn the concept of production and service systems.
2	To understand the general principle techniques and types of forecasting.
3	To learn the concept of inventory management.
4	To learn the principles of routing and it effect and methods of scheduling and controlling policies and aspects.
5	To understand dispatching procedures and role of computer in production planning and control.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate various production and service systems in production planning and control.	K1
CO2	Summarize the concept of forecasting and their techniques.	K2
CO3	Recall the inventory management and its techniques.	K3
CO4	Utilize routing procedure, bill of material and scheduling processes and apply different scheduling and balancing techniques.	K3
CO5	Explain dispatching procedure and role of computer in production planning and control.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	1	-	-	-	-	-	-	-	1	1
CO2	-	3	2	2	1	-	-	-	2	1	1	-	3	2
CO3	-	3	2	-	1	-	-	-	2	1	1	-	1	1
CO4	2	3	2	2	1	-	-	-	2	1	1	-	3	2
CO5	2	2	2	1	1	-	-	-	2	-	-	-	1	1

COURSE CONTENT

UNIT I

INTRODUCTION: Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department – Product design factors – Process Planning sheet.

UNIT II

FORECASTING – Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques– qualitative methods and quantitative methods.

UNIT III

INVENTORY MANAGEMENT: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P– Systems and Q-Systems. Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts, Introduction to supply chain management.

UNIT IV

ROUTING: Definition – Routing procedure – Route sheets – Bill of material – Factors affecting routing procedure. Scheduling – definition –Difference with loading.

SCHEDULING POLICIES: Techniques, standard scheduling methods. line balancing, aggregate planning, chase planning, expediting, controlling aspects.

UNIT V

DISPATCHING: Activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control.

TEXT BOOKS

1. Elements of Production Planning and Control / Samuel Eilon.
2. Manufacturing, Planning and Control, Partik Jonsson Stig-Arne Mattsson, Tata Mc Graw Hill

REFERENCE BOOKS

1. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
2. Production Planning and Control, Mukhopadyay, PHI.
3. Production Control a Quantitative Approach / John E. Biegel.
4. Production Control / Moore.

WEB RESOURCES

1. https://nptel.ac.in/courses/112/107/112107143/
2. https://cosmolearning.org/video-lectures/mod-1-lec-1-production-planning-and-control-8823/
3. https://m.videoken.com/embed/9qBZyzjoqAo

IV Year I Semester
HIGHWAY ENGINEERING

Course Category	Open Elective	**Course Code**	20CE7T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To introduce the students with the principles and practice of transportation engineering which focuses on Highway Engineering.
2	Ability to mathematically develop and interpret design standards for horizontal and vertical geometry and super elevation
3	To provide basic knowledge on materials used in pavement construction.
4	To enable the students to have a strong analytical and practical knowledge of Planning, Designing of Pavements.
5	To provide basic knowledge in traffic engineering, and transportation planning.

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Plan highway network for a given area.
CO2	Design the Highway geometrics based on highway alignment.
CO3	Characterize the pavement materials like aggregates, Bituminous materials &construction.
CO4	Judge suitability of pavement materials and design flexible and rigid pavements.
CO5	Design Intersections and prepare traffic management plans.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-

COURSE CONTENT	
UNIT I	**Highway Planning and Alignment:** Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans – First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.
UNIT II	**Highway Geometric Design:** Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Horizontal Alignment- Design of Super elevation and Extra widening- Design of Transition Curves- Design of Vertical alignment- Gradients- Vertical curves.
UNIT III	**Highway Materials:** Sub-grade soil: classification –Group Index – Subgrade soil strength – California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties -Tests on Bitumen.

UNIT IV	**Design of Pavements:** Types of pavements; Functions and requirements of different components of pavements; Design Factors **Flexible Pavements:** Design factors – Flexible Pavement Design Methods – CBR method – IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements. **Rigid Pavements:** Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.
UNIT V	**Traffic Engineering:** Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies; Speed studies –spot speed and speed & delay studies; Parking Studies; Road Accidents- Causes and Preventive measures - Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals –Webster Method –IRC method.

TEXT BOOKS	
1.	Highway Engineering' by Paul H. Wright and Karen K Dixon, Wiley Student Edition, Wiley India (P)Ltd., New Delhi.
2.	Highway Engineering' by Khanna S.K., Justo C.E.G and Veeraragavan A, Nem Chand Bros, Roorkee.
REFERENCE BOOKS	
1.	Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall ofIndia Pvt. Ltd; New Delhi.
2.	'Highway Engineering' by Srinivasa Kumar R, Universities Press, Hyderabad
WEB RESOURCES	
1.	https://nptel.ac.in/downloads/105101087/

IV Year I Semester
BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS

Course Category	Open Elective	**Course Code**	20EE7T29
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To discuss about the different types of batteries.
2	To describe about the battery characteristic & parameters.
3	To apply the concepts of battery management system and design the battery pack.
4	To explain about the battery testing, disposal and recycling.
5	To describe different methods of EV charging

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Discuss about the different types of batteries.	K2
CO2	Describe about the battery characteristic & parameters.	K2
CO3	Apply the concepts of battery management system and design the battery pack.	K3
CO4	Explain about the battery testing, disposal and recycling.	K2
CO5	Describe different methods of EV charging	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	1	1	-	1	1	1	-	-	-	-	1	1	1
CO4	2	-	-	-	1	1	1	-	-	-	-	1	1	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1	1	1

COURSE CONTENT	
UNIT 1	**Batteries** Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System Suggested reading: Study of different types of batteries
UNIT 2	**Battery Characteristics & Parameters** Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

UNIT 3	**Battery Pack and Battery Management System** Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests
UNIT 4	**Battery Testing, Disposal & Recycling** Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.
UNIT 5	**Charging Stations** Electric Vehicle Technology and Charging Equipment's, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, AC charging and DC charging, Inboard and off board charger specification, Type of Mode of charger Mode -2, Mode-3 and Mode-4, EVSE associated charge times calculation.

TEXT BOOKS	
1	Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
2	Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2)
REFERENCE BOOKS	
1	Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley& Sons Ltd., 2016.
2	Chris Mi, Abul Masrur & David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3	G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)"
4	T R Crompton, "Battery Reference Book-3 rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.
5	James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108106170
2	https://www.youtube.com/watch?v=omnQN5Z5vsA

IV Year I Semester
INDUSTRIAL ELECTRONICS

Course Category	Open Elective	**Course Code**	20EC7T40
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
Student will learn	
1	The building block for differential amplifier and operational amplifier using DC amplifiers and applications of OP-AMP.
2	a Voltage Regulator, Types of Voltage Regulators and their working and use of a different voltage regulators for real time applications
3	The characteristics and operation of SCR and Thyristor and techniques to turn Off a Thyristor
4	The operation and applications of important switching devices such as DIAC and TRIAC much used in power electronics
5	The different electronic devices such as Electronic timers and Electronic DC Motor and Control, Electric Welding methods, high frequency heating, ultrasonic generation required for industrial applications

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the concept of DC amplifiers.	K2
CO2	Analyze and design different voltage regulators for real time applications	K2
CO3	Describe the basis of SCR and Thyristor	K2
CO4	Determine the performance of DIAC and TRIAC	K2
CO5	Develop real time application using electronics	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	**1**	-	-	-	-	-	-	-	1	-
CO2	2	2	2	-	-	-	-	-	-	-	1	1
CO3	2	2	2	-	-	-	-	-	-	-	1	1
CO4	2	2	2	-	-	-	-	-	-	-	1	1
CO5	2	2	2	-	-	-	-	-	-	-	1	1

COURSE CONTENT	
UNIT I	**DC Amplifiers:** Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

UNIT II	**Regulated Power Supplies:** Block diagram, Principle of voltage regulation, Series and Shunttype Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection. Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting
UNIT III	**SCR and Thyristor:** Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.
UNIT IV	**Applications of SCR in Power Control:** Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave. DIAC, TRIAC and Thyristor Applications: Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation
UNIT V	**Industrial Applications -I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital Timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control. **Industrial Applications –II**: High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications

TEXT BOOKS	
1.	Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2.	Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972
REFERENCE BOOKS	
1.	Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edition, 2003
2.	Thyristors and applications – M. Rammurthy, East-West Press, 1977.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/108102145

IV Year I Semester
BIG DATA ANALYTICS

Course Category	Professional Core	**Course Code**	20DS6T02
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSEOBJECTIVES	
1	To optimize business decisions and create competitive advantage with Big Data analytics
2	To learn to analyze the big data using intelligent techniques
3	To introduce programming tools PIG & HIVE in Hadoop echo system

COURSEOUTCOMES		**Cognitive level**
Upon successful completion of the course, the student will be able to:		
CO1	Illustrate big data challenges in different domains including social media, transportation, finance and medicine	K2
CO2	Enumerate and apply the features of Cassandra	K2
CO3	Design and develop Hadoop and Map Reduce programs	K3
CO4	Perform data analysis using Apache Spark	K2
CO5	Analyze the data analytics process with a case study	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1–Low,2-Medium,3– High)

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	-	-	-	-	-	-	-	1	1	1
2	3	1	1	2	2	-	-	-	-	-	-	1	-	-	1
3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1
4	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1
5	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1

COURSECONTENT	
UNIT I	**Types of Digital Data:** Classification of Digital Data. Introduction to Big Data: Characteristic of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What is Big Data? **Big Data Analytics:** Where do we Begin?, What is Big Data Analytics?, What Big Data Analytics isn't?, Classification of Analytics, Terminologies Used in Big Data Environments. The Big Data Technology Landscape: NoSQL. **(Text Book 1)**
UNIT II	**Introduction to Cassandra:** Apache Cassandra – An Introduction, Features of Cassandra, CQL Data Types, CQLSH, Keyspaces, CRUD, Collections, Using a Counter, Time to Live, Alter Commands, Import and Export. **(Text Book 1)**
UNIT III	**Hadoop**: Hadoop Overview, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator). **MAPREDUCE:** Introduction to MAPREDUCE Programming: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. **(Text Book 1)**
UNIT IV	**Introduction to Data Analysis with Spark**: What is Apache Spark, A unified Spark, Who uses Spark and for what?, A Brief History of Spark, Spark version and releases, Storage layers for Spark.

	Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. **(Text Book 2)**
UNIT V	**JasperReport using Jaspersoft:** Introduction to JasperReports, Connecting to MongoDB NoSQL Database, Connecting to Cassandra NoSQL Database. **Few Interesting Differences:** Difference between Data Warehouse and Data Lake, Difference between RDBMS and HDFS, Difference between HDFS and HBase, Difference between Hadoop MapReduce and Spark, Difference between Pig and Hive **(Text Book 1)**

TEXTBOOKS	
1.	Big Data and Analytics by Seema Acharya, Subhashini Chellappan, Second Edition, Wiley India Pvt. Ltd., 2019
2.	Learning Spark: Lightning-Fast Big Data Analysis by Andy Konwinski, Holden Karau, Matei Zaharia, Patrick Wendell, First Edition, O'Reilly, 2015
REFERENCEBOOKS	
1.	Big Data Analytics, by Radha Shankarmani, M Vijayalakshmi, Second Edition, Wiley India Pvt. Ltd., 2016
2.	Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
3.	Hadoop: The Definitive Guide by Tom White, O'Reilly Media, Inc., 2009
4.	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons, 2014.
WEBRESOURCES	
1.	http://hadoop.apache.org/
2.	https://nptel.ac.in/courses/106104189/
3.	https://www.edx.org/course/big-data-fundamentals
4.	https://www.coursera.org/specializations/big-data
5.	https://www.wileyindia.com/big-data-and-analytics-2ed.html

IV Year I Semester
ORGANIZATIONAL BEHAVIOUR

Course Category	Open Elective	**Course Code**	20HM7T09
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the meaning and importance of Organizational Behaviour to start and survive in corporate environment.	K2
CO2	Demonstrate how the perception can integrate in human behaviour, attitudes and values.	K2
CO3	Understand the importance of Groups and Teams in organizations for better Decision making.	K2
CO4	Understand the need for change and its importance in organizations.	K2
CO5	Understand the culture of organizations and to apply techniques in dealing with stress in organizations.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	2	2	2	-	2	-	-
CO2	-	-	-	-	-	1	-	3	2	3	-	2	-	-
CO3	-	-	-	-	-	1	-	2	3	3	-	2	-	-
CO4	-	-	-	-	-	1	-	3	3	2	-	2	-	-
CO5	-	-	-	-	-	3	-	1	2	2	-	2	-	-

COURSE CONTENT

UNIT I
Introduction to Organizational Behaviour
Concept-Nature and scope-Importance of Organizational Behaviour-Key elements of Organizational Behaviour-Role of managers in Organizational Behaviour-Approaches to Organizational Behaviour-Perspectives of Human Behaviour-Challenges and Opportunities for Organizational Behaviour.

UNIT II
Perceptual Management
Nature-Process of Perception- Organization and Interpretation-Influencing factors- Importance of Perception in OB - Perceptual Errors- Attitudes and Values –Changes and Behaviour Modification Techniques-Impression Management.

UNIT III
Introduction to Groups and Teams
Meaning –Importance of Groups - Foundations of Group Behaviour –Reasons for Group formation-Group and Team-Types of Groups-Stages of Group development –Meaning and Importance of Teams- Factors affecting Group and Team performance-Types of teams-Creating an effective Team.

UNIT IV

Organization Change and Development

Definition and Meaning - Need for change-Forces for changes in Organization-Types of change-Organizational Resistance-Strategies overcome Resistance-Process of change-Meaning and Definition of Organization Development-OD interventions.

UNIT V

Organizational Culture and Organizational Stress

Organizational culture: Meaning and Nature of Organizational Culture-Functions-Types-Creating and maintain Organizational Culture-Managing Cultural Diversity. Organizational Stress: Definition and Meaning-Sources of stress-Impact of stress on organizations-Stress Management Techniques.

TEXT BOOKS

1. K.Aswathappa: "Organizational Behaviour-Text, Cases and Games", Himalaya Publishing House, New Delhi, 2017.
2. Stephen P. Robbins, Timothy, A. Judge: "Essentials of Organizational Behaviour" Pearson,2017
3. Pareek Udai, Sushma Khanna: "Understanding Organizational Behaviour", Oxford University Press, New Delhi, 2016.

REFERENCE BOOKS

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2015
2. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma: "Organizational Behavior", Tata McGraw Hill Education, New Delhi, 2017.
3. Jerald Greenberg and Robert A Baron: "Behavior in Organizations", PHI Learning Private Limited, New Delhi, 2013.
4. Jai B.P.Sinha: "Culture and Organizational Behavior", Sage Publication India Private Limited, New Delhi, 2009.
5. New strom W. John& Davis Keith, Organisational Behaviour--Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.

WEB RESOURCES

1. https://www.diversityresources.com/cultural-diversity-workplace/
2. https://www.chanty.com/blog/problem-solving-techniques/
3. https://www.simplypsychology.org/perspective.html#:~:text=The%20five%20major%20perspectives%20in,%2C%20behavioral%2C%20cognitive%20and%20humanistic
4. https://theintactone.com/2019/06/18/mpob-u3-topic-6-perception-process-and-errors

IV Year I Semester
WATER RESOURCE ENGINEERING

Course Category	Open Elective	**Course Code**	20CE7T18
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To introduce hydrologic cycle and its relevance to Civil engineering.
2	Make the students understand physical processes in hydrology and, components of the hydrologic cycle.
3	Appreciate concepts and theory of physical processes and interactions.
4	Learn measurement and estimation of the components hydrologic cycle.
5	Provide an overview and understanding of Unit Hydrograph theory and its analysis.
6	Understand flood frequency analysis, design flood, flood routing.
7	Appreciate the concepts of groundwater movement and well hydraulics
8	Learn overview of flood routing and its effects.
9	Has to be understood and identify the flood occurring areas nearby.

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Explain the theories and principles governing the hydrologic processes and list out the forms of precipitation in real conditions.
CO2	Apply key concepts to several practical areas of engineering hydrology and related design aspects.
CO3	Design major hydrologic components for a need-based structures.
CO4	Estimate flood magnitude and carry out flood routing.
CO5	Demonstrate the recuperation test process in open wells.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	-	-	-	-	1	-	1	-	2
CO2	3	2	2	2	2	2	-	-	-	-	1	-	1	-	2
CO3	3	2	2	2	2	2	-	-	-	-	1	-	1	-	2
CO4	3	2	2	2	2	2	-	-	-	-	1	-	1	-	2
CO5	3	2	2	2	1	2	-	-	-	-	1	-	1	-	2

COURSE CONTENT	
UNIT I	INTRODUCTION: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data. Precipitation: Types and forms, measurement, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, Frequency of point rainfall, Rain fall data in India. Intensity-Duration-Frequency (IDF) curves, Depth-Area Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm, problems on average rainfall on towns
UNIT II	ABSTRACTIONS FROM PRECIPITATION: Introduction, Initial abstractions. EVAPORATION: Factors affecting, measurement, reduction, Analytical methods of Evaporation estimation. EVAPOTRANSPIRATION: Factors affecting, measurement, control, Potential

	Evapotranspiration over India. INFILTRATION: Factors affecting, Infiltration capacity curve, measurement, Infiltration Indices. Problems on ϕ-Index and W-Index.
UNIT III	RUNOFF: Catchment characteristics, Factors affecting runoff, components, computation-empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve. HYDROGRAPH ANALYSIS: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph. Problems on unit hydrograph.
UNIT IV	FLOODS: Causes and effects, frequency analysis - Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management, Design flood, Design storm. FLOOD ROUTING: Hydrologic storage routing, channel and reservoir routing- Muskingum and Puls methods of routing, flood control in India. ADVANCED TOPICS IN HYDROLOGY: Rainfall-Runoff Modelling, Instantaneous Unit Hydrograph (IUH) - Conceptual models - Clark and Nash models, general hydrological models- Chow - Kulandaiswamy model.
UNIT V	GROUNDWATER: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, specific capacity, permeability, transitivity and storage coefficient, types of wells, well loss, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of a open well-recuperation test.

TEXT BOOKS	
1.	„Engineering Hydrology" by Subramanya, K, Tata McGraw-Hill Education Pvt. Ltd, (2013), NewDelhi.
2.	„Engineering Hydrology" by Jayarami Reddy, P, Laxmi Publications Pvt. Ltd., (2013), New Delhi.
3.	"Irrigation and Water Power Engineering" by Punmia B C, P.B.B Lal, A.K. Jainand A.K. Jain (2009), Laxmi Publications Pvt. Ltd., New Delhi.
REFERENCE BOOKS	
1.	'Water Resources Engineering', Mays L.W, Wiley India Pvt. Ltd, (2013).
2.	'Hydrology' by Raghunath. H.M., New Age International Publishers,(2010).
3.	'Engineering Hydrology –Principles and Practice' by Ponce V.M., Prentice Hall International,(1994).
4.	'Hydrology and Water Resources Engineering' by Patra K.C., Narosa Publications,(2011).
5.	'Applied hydrology' by Chow V.T., D.R Maidment and L.W. Mays, Tata McGraw Hill Education Pvt.Ltd., Transportation Engineering-Id., (2011), NewDelhi.
6.	'Engineering Hydrology' by Ojha C.S.P, R. Berndtsson and P. Bhunya, Oxford University Press, (2010).
WEB REFERENCES	
1.	https://www.digimat.in/nptel/courses/video/105104103/L01.html

IV Year I Semester
SMART GRID TECHNOLOGIES

Course Category	Open Elective	**Course Code**	20EE7T30
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To understand the basic concepts of smart grid.
2	To understand various smart grid technologies and its usage in smart applications.
3	To realize substation automation with intelligent sensors and have an idea on battery energy storage systems.
4	To have basic knowledge on micro grids and DG's.
5	To have an idea on communication technologies used in smart grid.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Know the concepts of smart grids and analyze the smart grid policies and developments in smart grids.	K2
CO2	Analyze the concepts of smart grid technologies in hybrid electrical vehicles etc.	K4
CO3	Know the concepts of smart substations - feeder automation - Battery Energy storage systems etc.	K2
CO4	Analyze micro grids and distributed generation systems.	K4
CO5	Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	1	1	1	1	-	-	-	-	1	2	2
CO2	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO3	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO4	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO5	3	2	1	1	1	1	1	-	-	-	-	1	2	2

COURSE CONTENT	
UNIT 1	**Introduction to Smart Grid** Evolution of Electric Grid - Concept of Smart Grid - Definitions - Need of Smart Grid - Functions of Smart Grid - Opportunities & Barriers of Smart Grid - Difference between conventional & smart grid - Concept of Resilient & Self-Healing Grid - Present development & International policies on Smart Grid.
UNIT 2	**Smart Grid Technologies-1** Introduction to Smart Meters - Real Time Pricing - Smart Appliances - Automatic Meter Reading (AMR) - Outage Management System (OMS) - Plug in Hybrid Electric Vehicles (PHEV) - Vehicle to Grid - Smart Sensors - Home & Building Automation - Phase Shifting Transformers - Net Metering.
UNIT 3	**Smart Grid Technologies- 2**

	Smart Substations - Substation Automation - Feeder Automation. Geographic Information System(GIS) - Intelligent Electronic Devices (IED) & their application for monitoring & protection. Smart storage like Battery Energy Storage Systems (BESS) - Super Conducting Magnetic Energy Storage Systems (SMES) - Pumped Hydro - Compressed Air Energy Storage (CAES)
UNIT 4	**Micro grids and Distributed Energy Resources** Concept of micro grid - need & applications of microgrid - formation of microgrid - Issues of interconnection - protection & control of microgrid - Integration of renewable energy sources - Demand Response.
UNIT 5	**Information and Communication Technology for Smart Grid** Advanced Metering Infrastructure (AMI) - Home Area Network (HAN) - Neighborhood Area Network (NAN) - Wide Area Network (WAN).

TEXT BOOKS	
1	Integration of Green and Renewable Energy in Electric Power Systems - by Ali Keyhani - Mohammad N. Marwali - Min Dai Wiley - 2009.
2	The Smart Grid: Enabling Energy Efficiency and Demand Response - by Clark W.Gellings - Fairmont Press - 2009.
REFERENCE BOOKS	
1	The Advanced Smart Grid: Edge Power Driving Sustainability:1 by Andres Carvallo - John Cooper - Artech House Publishers July 2011
2	Control and Automation of Electric Power Distribution Systems (Power Engineering) by James Northcote - Green - Robert G. Wilson - CRC Press - 2017.
3	Substation Automation (Power Electronics and Power Systems) by MladenKezunovic - Mark G. Adamiak - Alexander P. Apostolov - Jeffrey George Gilbert - Springer - 2010.
4	Electrical Power System Quality by R. C. Dugan - Mark F. McGranghan - Surya Santoso -H. Wayne Beaty - McGraw Hill Publication - 2nd Edition.
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108107113
2	https://electrical-engineering-portal.com/smart-grid-concept-and-characteristics

IV Year I Semester
BIO-MEDICAL INSTRUMENTATION

Course Category	Open Elective	**Course Code**	20EC7T41
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: In this course the student will	
1	Study the physiological relation of human body – environment and Identify various errors that occur while measuring living system
2	Study various types of Electrodes and Transducers used in biomedical measurements
3	Learn Anatomy of Heart, Respiratory system and the measuring instruments.
4	Learn various fundamental blocks in patient care and monitoring
5	Study various diagnostic and therapeutic techniques

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Acquainted with the function of human body and measure active and resting potentials of cell bodies.	K2
CO2	Measure the Bioelectric potential using appropriate electrodes and Transducers.	K2
CO3	Know the mechanism and measurement of ECG for the Cardiac cycle and respiratory system	K2
CO4	Monitor the Patient care monitoring system and applications of therapeutic equipment	K2
CO5	Know the working principles of diagnostic equipment	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	1	1	2	-	-	-	-	-	-	-	-	-	-	1
CO4	-	1	2	2	-	-	-	-	-	-	-	-	-	1
CO5	-	1	1	1	2	-	-	-	-	-	-	-	1	-

COURSE CONTENT	
UNIT I	**INTRODUCTION TO BIOMEDICAL INSTRUMENTATION:** Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Problems Encountered in Measuring a Living System, Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potential, Bioelectric Potentials-ECG, EEG and EMG, Bio amplifiers

UNIT II	**ELECTRODES AND TRANSDUCERS:** Introduction to Electrode Theory, Biopotential Electrodes, Examples of Electrodes, Basic Transducer principles, Biochemical Transducers, The Transducer and Transduction principles, Active Transducers, Passive Transducers.
UNIT III	**CARDIOVASCULAR SYSTEM AND MEASUREMENTS:** The Heart and Cardiovascular System, Electro Cardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart sound, Plethysmography, Angiogram and Angioplasty **RESPIRATORY SYSTEM AND MEASUREMENTS:** The Physiology of the Respiratory System, Tests and Instrumentation for the Mechanics of Breathing, Respiratory Therapy Equipment.
UNIT IV	**PATIENT CARE AND MONITORING:** Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring equipmentOther Instrumentation for Monitoring Patients, Pacemakers, Defibrillators, Ventilators, Radio Frequency applications of Therapeutic use, ECG & EEG Recorders.
UNIT V	**DIAGNOSTIC TECHNIQUES AND BIO-TELEMETRY:** Principles of Ultrasonic Measurement, Ultrasonic imaging, Ultrasonic Applications of Therapeutic uses, Ultrasonic diagnosis, X-Ray and Radio-Isotope instrumentations, CAT Scan, Emission Computerized Tomography, MRI, and Telemedicine Technology.

TEXT BOOKS	
1.	Fundamentals of biomedical instrumentation –Dr.O.N.Pandey, S.K.Kataria & sons,4 th edition,2012
2.	Bio-Medical Instrumentation – Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, 2nd edition, PHI, 2011.
REFERENCE BOOKS	
1.	Hand Book of Bio-Medical Instrumentation – R.S.Khandapur, McGrawHill, 2nd edition, 2003.
2.	Biomedical Instrumentation – Dr. M. Arumugam, Anuradha Publications, 2006
WEB RESOURCES	
1.	http://www.digimat.in/nptel/courses/video/108105101/L28.html

IV Year I Semester
CRYPTOGRAPHY AND NETWORK SECURITY

Course Category	Open Elective	**Course Code**	20IT7T10
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
The objective of the course is to	
1	The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and SSL/TLS.

COURSE OUTCOMES		**Cognitive level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain different security threats and countermeasures and foundation course of cryptography mathematics.	K1
CO2	Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography	K2
CO3	Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more	K2
CO4	Design applications of hash algorithms, digital signatures and key management techniques	K3
CO5	Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL, TSL, and IPsec	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	1	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	1	2	-	-	-	-	-	-	-	2	2	2
CO3	3	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	2	3	3	3	-	-	-	-	-	-	-	1	1	2
CO5	3	2	3	3	3	-	-	-	-	-	-	-	1	1	2

COURSE CONTENT	
UNIT I	**Basic Principles:** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.
UNIT II	**Symmetric Encryption:** Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.
UNIT III	**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography
UNIT IV	**Data Integrity, Digital Signature Schemes & Key Management:** Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.
UNIT V	**Network Security - I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS,

	Network Security - II: Security at the Network Layer: IPSec, System Security
TEXT BOOKS	
1.	Cryptography and Network Security, 3rd Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill, 2015
2.	Cryptography and Network Security, 4th Edition, William Stallings, (6e) Pearson,2006
3.	Everyday Cryptography, 1st Edition, Keith M.Martin, Oxford,2016
REFERENCE BOOKS	
1.	Network Security and Cryptography, 1st Edition, Bernard Meneges, Cengage Learning, 2018.

IV Year I Semester
MARKETING MANAGEMENT

Course Category	Open Elective	**Course Code**	20HM7T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the concepts of Marketing and Marketing Environment.	K2
CO2	Analyze the consumer behavior and market segmentation in order to maintain better consumer relations and product positioning respectively.	K4
CO3	Make use of strategies and make decisions based on product life cycle and product mix concepts.	K3
CO4	Understand the pricing effects and select a better distribution channel to reach the consumer.	K2
CO5	Understand the promotional methods and importance.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	2	-	-	1	1	1	-	1	1	-	-	-
CO2	-	-	1	-	-	1	-	2	1	-	1	-	-	-
CO3	-	-	1	2	1	2	1	1	-	-	1	1	-	-
CO4	-	-	1	-	-	1	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	1	1	1	1	1	1	1	-	-

COURSE CONTENT

UNIT I

Introduction to Marketing: Market and Marketing, Functions, importance and problems of marketing – Marketing Environment, Approaches to the study of marketing – Institutional Approach, Commodity approach, Management approach, systems approach to marketing. Marketing Mix(7 p's of Marketing.)

UNIT II

Consumer Behavior and CRM

Meaning and features and Factors influencing Consumer Behavior – Theories of Buying Behavior (Economic theories – Marshallion model, psychological theories, psycho-analytic theories, socio-cultural theories) – buying decision process - Customer Relationship Management.

Market Segmentation

Market Segmentation – Bases of Segmenting Consumer Market and Industrial Market – Target Marketing – Product differentiation – Product Positioning.

UNIT III

Product decision: New product development – Product mix – management of product life cycle – product strategies – product additions and deletions.

Branding, packaging and labeling – product differentiation – planned obsolescence.

UNIT IV

Pricing and Channels of distribution:

Pricing: Pricing objectives – Pricing methods – Pricing strategies.

Channels of Distribution: Nature and types of marketing channels – wholesale distribution- retail distribution – direct marketing – selection of channels, Logistics, Third Party Service providers.

UNIT V

Promotion: Nature and Importance of promotion – promotional methods of personal selling: objectives and function, Advertising objectives – Message content – media selection – Advertising agency – Advertising Budgets – Measuring Advertising effectiveness; Sales promotion Techniques – Social Media Promotion

TEXTBOOKS

1. Phil T.Kotler – Marketing Management - Pearson Education limited – 2019
2. S.A.Sherlekar – Marketing Management - Himalaya Publishing House - 2019
3. Dr. K.Karunakaran – Marketing Management Himalaya Publishing House – 2010.

REFERENCE BOOKS

1. Priyanka Goel - Marketing Management – Atlantic publications - 2019.
2. Philip Kotler and Lane Keller - Marketing Management – Pearson Educaion ltd - 2017
3. L.Natarajan – Marketing Management – Margham Publications - 2012

WEB RESOURCES

1. https://www.tutorialspoint.com/marketing_management/marketing_management_functions
2. https://keydifferences.com/difference-between-branding-and-packaging.html
3. https://smallbusiness.chron.com/product-mix-639.html

IV Year I Semester
UNIVERSAL HUMAN VALUES-2 UNDERSTANDING HARMONY

Course Category	Basic Science	**Course Code**	20HM7T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession	K2
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	K1
CO3	Understand the role of a human being in ensuring harmony in society and nature.	K2
CO4	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	K1
CO5	Understand the current scenario in technology with respect to the Professional Ethics	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	3	-	3	-	-	-	3	-	-
CO2	-	-	-	-	-	3	-	3	3	-	-	-	-	-
CO3	-	-	-	-	-	3	2	3	3	-	-	-	-	-
CO4	-	-	-	-	-	3	-	3	3	-	-	-	-	-
CO5	-	-	-	-	-	3	-	3	3	-	-	-	-	-

COURSE CONTENT

UNIT I
Introduction to Value Education: Value Education, Definition, Concept and Need for Value Education, Content and Process of Value Education, Basic Guidelines for Value Education, Self exploration as a means of Value Education, Happiness and Prosperity as parts of Value Education.

UNIT II
Harmony in the Human Being: Human Being is more than just the Body, Harmony of the Self ('I') with the Body, Understanding Myself as Co-existence of the Self and the Body, Understanding Needs of the Self and the needs of the Body, Understanding the activities in the Self and the activities in the Body.

UNIT III
Harmony in the Family and Society and Harmony in the Nature: Family as a basic unit of Human Interaction and Values in Relationships, The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour, Harmony in Nature: The Four Orders in Nature, The Holistic Perception of Harmony in Existence.

UNIT IV

Social Ethics: The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct, Holistic Alternative and Universal Order, Universal Human Order and Ethical Conduct, Human Rights violation and Social Disparities.

UNIT V

Professional Ethics: Value based Life and Profession, Professional Ethics and Right Understanding, Competence in Professional Ethics, Issues in Professional Ethics – The Current Scenario, Vision for Holistic Technologies, Production System and Management Models.

TEXTBOOKS

1. A.N Tripathy, New Age International Publishers, 2003.
2. Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics

REFERENCE BOOKS

1. Corliss Lamont, Philosophy of Humanism
2. Gaur. R.R., Sangal. R. Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
3. Gaur. R.R., Sangal. R. Bagaria. G.P, Teachers Manual Excel Books, 2009.
4. I.C. Sharma. Ethical Philosophy of India Nagin & co Julundhar
5. Mortimer. J. Adler, – Whatman has made of man
6. William Lilly Introduction to Ethic Allied Publisher

WEB RESOURCES

1. https://www.tandfonline.com/doi/abs/10.2753/RSP1061-1967330482?journalCode=mrsp20
2. https://www.thefbcg.com/resource/building-family-harmony-starts-with-living-our-values/#:~:text=What%20does%20family%20harmony%20mean,family%20as%20a%20larger%20unit

IV Year I Semester
MECHATRONICS LABORATORY

Course Category	Skill Oriented	**Course Code**	20ME7S02
Course Type	Laboratory	**L-T-P-C**	0-0-4-2
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	00 50 50

COURSE OBJECTIVES	
Students will learn	
1	The concepts of various hydraulic, pneumatic and electro-pneumatic circuits and transducers.
2	The method of programming the microprocessor and also the design, modelling & analysis of basic electrical system which enable the students to understand the concept of mechatronics.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the functioning of hydraulic, pneumatic and electro-pneumatic circuits.	K2
CO2	Develop PLC programs for real time applications like control of traffic lights, water level, and lifts.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	2	-	-	2	3	-
CO2	3	2	2	2	-	-	-	-	2	-	-	2	3	-

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Study of hydraulic, pneumatic and electro-pneumatic circuits.
3. Study of various types of transducers.
4. Study of PLC and its applications.
5. Introduction to PLC Programming
6. Ladder programming on Logic gates, Timers & counters.
7. Ladder programming for Traffic Light control.
8. Ladder programming for Water level control.
9. Ladder programming for Lift control Modules.
10. Sample programme on MATLAB