Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

REGULATION 2018

CURRICULUM AND SYLLABI

B.E. MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

SRI KRISHNA COLLEGE OF ENGNEERING AND TECHNOLOGY

An Autonomous Institution Affiliated to Anna University
Kuniamuthur,
Coimbatore - 641 008

VISION AND MISSION OF THE DEPARTMENT

Vision

The department aspires to produce experts in Mechanical Engineering with moral values and desires to set up centers of excellence in innovative design and testing, composite materials, automation, automotive technology and green fuels.

Mission

To produce world class mechanical engineering graduates by promoting core technical competency blended with advanced computing skills, creative thinking and desire to upgrade continuously, so as to empower them to the expectation of the industries in our country and abroad and also to impart the interpersonal skills and make them realize the values of life.

Programme Outcomes (POs):-

At the time of their graduation students of Mechanical Engineering Programme should be in possession of the following Programme Outcomes

a.	An ability to apply knowledge of mathematics, science, and engineering fundamentals in order to solve mechanical engineering problems
b.	An ability to design and conduct experiments, as well as to analyze and interpret data using research based knowledge to give suitable conclusions.
c.	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and Sustainability.
d.	An ability to function as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
e.	An ability to identify, formulate, research literature and analyze complex engineering problems reaching substantiate conclusions using first principles of mathematics, sciences and engineering.
f.	An understanding of professional and ethical responsibility and norms of the engineering practice.
g.	An ability to communicate effectively on complex engineering activities with engineering and society communities and write reports, documentation and presentation effectively.
h.	An ability to understand the impact of the professional engineering solutions in a societal and environmental context and demonstrate the knowledge of, need for sustainable development.
i.	A recognition of the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
j.	A knowledge of contemporary issues (Our interpretation of this includes presenting students with issues such as the impact of globalization, the outsourcing of both engineering and other support jobs as practiced by modern international companies).
k.	An ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Programme Educational Objectives (PEOs):-

The following Programme Educational Objectives are designed based on the department mission

PEO 1: Provide strong foundation in the science and engineering fundamentals necessary to formulate, solve and analyze real time mechanical engineering problems.

PEO 2: Develop the ability to synthesize data and technical concepts for making decisions in an ethical manner considering the socio-economic scenario.

PEO 3: Enable to work as part of teams on multidisciplinary projects with good communication and interpersonal skills in the emerging areas like automation, composite materials, automotive technology, green fuels etc.,

PEO 4: Prepare for successful careers in industry that meet the needs of Indian and multinational companies and to inculcate the qualities of continuous learning and entrepreneurial skills.

Mapping of PO's to PEO's

Programme Educational Objectives	**Programme Outcomes**										
	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
PEO 1	3	3	3	3	3	1	2	3	3	1	2
PEO 2	3	3	3	2	3	2	2	2	2	1	3
PEO 3	3	3	3	2	3	3	2	3	3	1	2
PEO 4	3	3	3	3	3	3	2	3	3	2	3

3	Strongly agreed	**2**	Moderately agreed	**1**	Reasonably agreed

Programme Specific Outcomes (PSO's):-

At the end of the Programme, Graduate shall have

PSO 1	Design, develop and analyse the engineering components using advanced design softwares.
PSO 2	An ability to fabricate real time mechanical systems and test its worthiness.
PSO 3	An ability to apply the advancements in mechanical engineering to promote automation.

B.E. MECHANICAL ENGINEERING
REGULATION 2018
CHOICE BASED CREDIT SYSTEM
I – VIII SEMESTER CURRICULUM AND SYLLABI

SEMESTER I								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18MA101	Linear Algebra and Differential Calculus	3/1/0	4	4	-	50/50	BSC
THEORY CUM PRACTICAL								
2.	18EN102	Technical Communication Skills	2/0/2	4	3	-	40/60	HSMC
3.	18CH101	Engineering Chemistry	3/0/3	6	4.5	-	40/60	BSC
4.	18CS111	Problem Solving using C Programming	3/0/3	6	4.5	-	40/60	ESC
5.	18ME101	Engineering Drawing	2/0/2	4	3	-	40/60	ESC
MANDATORY COURSE								
6.	18MC101	Induction Programme	3 WEEKS		-	-	0/100	MC
		Total	**13/1/10**	**24**	**19**	**-**	**600**	
SEMESTER II								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18MA201	Integral Calculus and Complex Variables	3/1/0	4	4	-	50/50	BSC
2.	18ME201	Engineering Mechanics	3/1/0	4	4	-	50/50	ESC
THEORY CUM PRACTICAL								
3.	18PH201	Engineering Physics	3/0/3	6	4.5	-	40/60	BSC
4.	18EE211	Basics of Electrical and Electronics Engineering	3/0/3	6	4.5	-	40/60	ESC
5.	18ME102	Engineering Practices Laboratory	1/0/4	5	3	-	40/60	ESC
MANDATORY COURSE								
6.	18MC201	Environmental Sciences	2/0/0	2	-	-	0/100	MC
		Total	**15/2/10**	**27**	**20**	**-**	**600**	

SEMESTER III								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18MA303	Fourier Series, Curve Fitting and Partial Differential Equations	3/1/0	4	4	-	50/50	BSC
2.	18ME301	Strength of Materials	3/1/0	4	4	-	50/50	PCC
3.	18ME302	Engineering Thermodynamics	3/1/0	4	4	-	50/50	PCC
THEORY CUM PRACTICAL								
4.	18ME303	Manufacturing Technology – I (with Lab)	3/0/2	5	4	-	40/60	PCC
5.	18ME304	Metallurgy and Materials Testing (with Lab)	3/0/2	5	4	-	40/60	PCC
PRACTICAL CUM THEORY								
6.	18EE311	Electrical Drives and Microprocessor Laboratory	1/0/3	4	2.5	-	40/60	ESC
PRACTICAL								
7.	18ME305	Machine Drawing and Engineering Tolerance	0/0/3	3	1.5	-	40/60	ESC
MANDATORY COURSE								
8.	18MCZZZ	Mandatory Course-III	2/0/0	2	-	-	0/100	MC
		Total	**18/3/10**	**31**	**24**	**-**	**800**	

SEMESTER IV								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18MA403	Statistics and Numerical methods	3/1/0	4	4	-	50/50	BSC
2.	18ME401	Automobile Engineering (Industry based Course)	2/0/2	4	3	-	50/50	PCC
3..	18ME402	Kinematics of Machinery	3/1/0	4	4	-	50/50	PCC
THEORY CUM PRACTICAL								
4.	18ME403	Fluid Mechanics and Machinery (with Lab)	3/0/2	5	4	-	40/60	PCC
5.	18ME404	Thermal Engineering (with Lab)	3/0/2	5	4	-	40/60	PCC
6.	18ME405	Manufacturing Technology- II (with Lab)	3/0/2	5	4	-	40/60	PCC
MANDATORY COURSE								
7.	18MCZZZ	Mandatory Course-IV	2/0/0	2	-	-	0/100	MC
		Total	**19/2/8**	**29**	**23**	**-**	**700**	

SEMESTER V								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18MEZZZ	Emerging Elective – I	3/0/0	3	3	-	50/50	EEC
2.	18ME501	Design of Machine Elements (Project based Course)	3/0/1	4	3.5	-	50/50	PCC
3.	18ME502	Industry 4.0	3/0/0	3	3	-	50/50	PCC
4.	18ME9ZZ	Professional Elective-I	3/0/0	3	3	-	50/50	PEC
THEORY CUM PRACTICAL								
5.	18ME503	Dynamics of Machinery (with Lab)	3/0/2	5	4	-	40/60	PCC
6.	18ME504	Heat and Mass Transfer (with Lab)	3/0/2	5	4	-	40/60	PCC
PRACTICAL CUM THEORY								
7.	18ME505	CAD/CAM Laboratory	1/0/3	4	2.5	-	40/60	PCC
8.	18ME506	Measurements and Instrumentation Laboratory	1/0/3	4	2.5	-	40/60	PCC
		Total	**20/0/11**	**31**	**25.5**	**-**	**800**	

SEMESTER VI								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18ME601	Design of Transmission Systems (Project based Course)	3/0/1	4	3.5	-	50/50	PCC
2.	18ME602	Computational Mechanics	3/0/0	3	3	-	50/50	PCC
3.	18ME9ZZ	Professional Elective-II	3/0/0	3	3	-	50/50	PEC
4.	18ME9ZZ	Professional Elective-III	3/0/0	3	3	-	50/50	PEC
5.	18XXZZZ	Open Elective- I	3/0/0	3	3	-	50/50	OEC
PRACTICAL CUM THEORY								
6.	18ME603	Mechatronics Laboratory	1/0/3	4	2.5	-	40/60	PCC
PRACTICAL								
7.	18ME604	Simulation and Analysis Laboratory	0/0/3	3	1.5	-	40/60	PCC
PROJECT WORK								
8.	18ME605	Mini Project – I	0/0/2	2	1	-	40/60	PROJ
		Total	**16/0/9**	**25**	**20.5**	**-**	**800**	

SEMESTER VII								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
THEORY								
1.	18ME701	Industrial Engineering and Operations Management	3/0/0	3	3	-	50/50	HSMC
2.	18MEZZZ	Emerging Elective - II	3/0/0	3	3	-	50/50	EEC
3.	18ME9ZZ	Professional Elective-IV	3/0/0	3	3	-	50/50	PEC
4.	18ME9ZZ	Professional Elective-V	3/0/0	3	3	-	50/50	PEC
5.	18ME9ZZ	Professional Elective - VI	3/0/0	3	3	-	50/50	PEC
6.	18XXZZZ	Open Elective - II	3/0/0	3	3	-	50/50	OEC
PROJECT WORK								
7.	18ME702	Phase I – Literature Review	0/0/3	3	1.5	-	40/60	PROJ
		Total	**18/0/3**	**21**	**19.5**	**-**	**700**	

SEMESTER VIII								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
PROJECT WORK								
1.	18ME801	Phase II – Project Work	0/0/24	24	12	-	40/60	PROJ
		Total	**0/0/24**	**24**	**12**	**-**	**100**	

EMPLOYABILITY ENHANCEMENT SKILLS								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./Int.**	**Cat.**
1.	18MEE01	Industrial Practice (21 Days) / Publication in Journals (National/International) / IPR	-	-	1.5	-	-	EES
		Total	**-**	**-**	**1.5**	**-**	**-**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

SL. No.	Stream	Credits/Semester								C	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences Including Management (HSMC)	3	-	-	-	-	-	3	-	6	3.64
2	Basic Sciences (BSC)	8.5	8.5	4	4	-	-	-	-	25	15.15
3	Engineering Sciences (ESC)	7.5	11.5	4	-	-	-	-	-	23	13.94
4	Professional Core (PCC)	-	-	16	19	19.5	10.5	3	-	65	39.39
5	Professional Electives (PEC)	-	-	-	-	3	6	9	-	18	10.91
6	Open Electives (OEC) / Emerging Elective Courses (EEC)	-	-	-	-	3	3	6	-	12	7.27
7	Project Work (PROJ)	-	-	-	-	-	1	1.5	12	14.5	8.79
8.	Employability Enhancement Skills (EES)	-	-	-	-	-	-	-	-	1.5	0.91
9.	Mandatory Course (MC)	-	-	-	-	-	-	-	-	-	-
Total		**19**	**20**	**24**	**23**	**25.5**	**20.5**	**19.5**	**12**	**165**	**100**

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

S.No.	Course Work - Subject Area	AICTE Suggested Credits	AICTE model curriculum credits	SKCET Credits (165)
1.	Humanities and Social Sciences (HS), including Management;	12*	6	6
2.	Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;	25*	30	25
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	24*	27	23
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required ;)	48*	50.5	65
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	18*	18	18
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	18*	12	12
7.	Project Work, Seminar and/or Internship in Industry or elsewhere.	15*	15	14.5
8.	Employability Enhancement Skills	Non-credit		1.5
9.	Mandatory Courses (MC);	Non-credit		
Total		160*	158.5	**165**
**Minor Variations is allowed as per need of the respective disciplines*				

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (9 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18EN102	Technical Communication skills	2/0/2	4	3	HSMC
3.	18ME701	Industrial Engineering and Operations Management	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (25 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18MA101	Linear Algebra and Differential Calculus	3/1/0	4	4	BSC
2.	18CH101	Engineering Chemistry	3/0/3	6	4.5	BSC
3.	18MA201	Integral Calculus and Complex Variables	3/1/0	4	4	BSC
4.	18PH201	Engineering Physics	3/0/3	6	4.5	BSC
5.	18MA303	Fourier Series, Curve fitting and Partial Differential Equations	3/1/0	4	4	BSC
6.	18MA403	Statistics and Numerical methods	3/1/0	4	4	BSC

ENGINEERING SCIENCE COURSES (23 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18CS111	Problem Solving using C Programming	3/0/3	6	4.5	ESC
2.	18ME101	Engineering Drawing	2/0/2	4	3	ESC
3.	18EE211	Basics of Electrical and Electronics Engineering	3/0/3	6	4.5	ESC
4.	18ME201	Engineering Mechanics	3/1/0	4	4	ESC
5.	18ME102	Engineering Practices Laboratory	1/0/4	5	3	ESC
6.	18EE311	Electrical Drives and Microprocessor Laboratory	1/0/3	4	2.5	ESC
7.	18ME305	Machine Drawing and Engineering Tolerance	0/0/3	3	1.5	ESC

PROFESSIONAL CORE COURSES (62 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18ME301	Strength of Materials	3/1/0	4	4	PCC
2.	18ME302	Engineering Thermodynamics	3/1/0	4	4	PCC
3.	18ME303	Manufacturing Technology – I (with Lab)	3/0/2	5	4	PCC
4	18ME304	Metallurgy and Materials Testing (with Lab)	3/0/2	5	4	PCC
5.	18ME401	Automobile Engineering (Industry based Course)	2/0/2	4	3	PCC

6.	18ME402	Kinematics of Machinery	3/1/0	4	4	PCC
7.	18ME403	Fluid Mechanics and Machinery (with Lab)	3/0/2	5	4	PCC
8.	18ME404	Thermal Engineering (with Lab)	3/0/2	5	4	PCC
9.	18ME405	Manufacturing Technology- II (with Lab)	3/0/2	5	4	PCC
10.	18ME501	Design of Machine Elements (Project based Course)	3/0/1	4	3.5	PCC
11	18ME502	Industry 4.0	0/0/3	3	3	PCC
12.	18ME503	Dynamics of Machinery (with Lab)	3/0/2	5	4	PCC
13.	18ME504	Heat and Mass Transfer (with Lab)	3/0/2	5	4	PCC
14.	18ME505	CAD/CAM Laboratory	1/0/3	4	2.5	PCC
15.	18ME506	Measurements and Instrumentation Laboratory	1/0/3	4	2.5	PCC
16.	18ME601	Design of Transmission Systems (Project based Course)	3/0/1	4	3.5	PCC
17.	18ME602	Computational Mechanics	3/0/0	3	3	PCC
18.	18ME603	Mechatronics Laboratory	1/0/3	4	2.5	PCC
19.	18ME604	Simulation and Analysis Laboratory	0/0/3	3	1.5	PCC

PROFESSIONAL ELECTIVE COURSES (18 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
ELECTIVE STREAM I – ENGINEERING DESIGN						
1.	18ME901	Product Design and Development	3/0/0	3	3	PEC
2.	18ME902	Tool and Die Design	3/0/0	3	3	PEC
3.	18ME903	Applied Hydraulics and Pneumatics	3/0/0	3	3	PEC
4.	18ME904	Design for Manufacturing and Assembly	3/0/0	3	3	PEC
5.	18ME905	Optimization Techniques in Engineering Design	3/0/0	3	3	PEC
6.	18ME906	Industrial Robotics	3/0/0	3	3	PEC
7.	18ME907	Mechanical Vibrations	3/0/0	3	3	PEC
8.	18ME908	Composite Materials and Mechanics	3/0/0	3	3	PEC
9.	18ME909	Engineering Tribology	3/0/0	3	3	PEC
ELECTIVE STREAM II - THERMAL ENGINEERING						
1	18ME910	Non-Conventional Energy Sources	3/0/0	3	3	PEC
2	18ME911	Refrigeration and Air Conditioning	3/0/0	3	3	PEC
3	18ME912	Alternate Energy Sources for Automobiles	3/0/0	3	3	PEC
4	18ME913	Turbo Machines	3/0/0	3	3	PEC
5	18ME914	Gas Dynamics and Jet Propulsion	3/0/0	3	3	PEC
6	18ME915	Power Plant Engineering	3/0/0	3	3	PEC
7	18ME916	Solar and Wind Energy	3/0/0	3	3	PEC
8	18ME917	Internal Combustion Engines	3/0/0	3	3	PEC
9	18ME918	Cryogenic Engineering	3/0/0	3	3	PEC

ELECTIVE STREAM III - MANUFACTURING /INDUSTRIAL ENGINEERING						
1	18ME919	Composite Materials, Processing and Applications	3/0/0	3	3	PEC
2	18ME920	Industrial Layout, Ergonomics and Safety Engineering	3/0/0	3	3	PEC
3	18ME921	Additive Manufacturing	3/0/0	3	3	PEC
4	18ME922	Lean Six sigma and Agile Manufacturing	3/0/0	3	3	PEC
5	18ME923	Theory of Metal Cutting	3/0/0	3	3	PEC
6	18ME924	Entrepreneurship Development and Managerial Skills	3/0/0	3	3	PEC
7	18ME925	Modern Manufacturing Processes	3/0/0	3	3	PEC
8	18ME926	Engineering Management and Financial Accounting	3/0/0	3	3	PEC
9	18ME927	Advanced Casting and Welding Processes	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES
(Offered to Other Branches)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18ME001	Industrial Safety	3/0/0	3	3	OEC
2.	18ME002	MEMS/NEMS	3/0/0	3	3	OEC
3.	18ME003	Total Quality Management	3/0/0	3	3	OEC
4.	18ME004	Product Development	3/0/0	3	3	OEC
5.	18ME005	Fundamentals of Additive Manufacturing	3/0/0	3	3	OEC
6.	18ME006	Fuel Cell Technology	3/0/0	3	3	OEC
7.	18ME007	Leagile Approach and Technology Management	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18ME008	Internet of Things for Mechanical Engineers	3/0/0	3	3	EEC
2.	18ME009	Data Analytics for Mechanical Engineers	3/0/0	3	3	EEC
3.	18ME010	Basics of Soft Computing Techniques	3/0/0	3	3	EEC
4.	18ME011	Expert System	3/0/0	3	3	EEC
5.	18ME012	Fundamentals of Machine Learning	3/0/0	3	3	EEC
6.	18ME013	Product Life Cycle Management	3/0/0	3	3	EEC

PROJECT WORK (14.5 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18ME605	Mini Project – I	0/0/2	2	1	PROJ
2.	18ME702	Phase I – Literature Review	0/0/3	3	1.5	PROJ
3.	18ME801	Phase II – Project Work	0/0/24	24	12	PROJ

EMPLOYABILITY ENHANCEMENT SKILLS (1.5 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18MEE01	Industrial Practice- (21 Days) / Publication in Journals (National/International) / IPR	-	-	1.5	EES

MANDATORY COURSES (Non Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	18MC101	Mandatory Course I	3 WEEKS		-	MC
2.	18MC201	Environmental Science*	2/0/0	2	-	MC
3.	18MC351	Ethics in Engineering Practice*	2/0/0	2	-	MC
4.	18MC352	Constitution of India and Essence of Indian Traditional Knowledge*	2/0/0	2	-	MC

* Courses conducted either by internal faculty or through MOOCs

ONE CREDIT COURSES (**Additional Credits)**

S.No	Course Code	Course Title	Credits
1.	18MEA01	Certification in Creo, ANSYS, CFD, LabVIEW, CATIA, NDT etc.,	1
2.	18MEA02	Any other certification from MNCs/OEMs, Texas Instruments, Bosch, Rexroth, SAE Skill India etc.,	1
3.	18MEA03	NSS	1
4.	18MEA04	Spoken Hindi	1
5.	18MEA05	Vehicle Design and Fabrication	1
6.	18MEA06	Foreign Language	1
7.	18MEA07	Massive Open Online Courses(MOOC) / NPTEL	1
8.	18MEA08	Industrial Training	1

SERVICE SUBJECTS

SL. No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	18ME102	Engineering Practices Laboratory	1/0/4	5	3	40/60	ES
2	18ME111	Engineering Graphics	2/0/2	4	3	40/60	ES

SEMESTER WISE CREDIT DISTRIBUTION:-

Semester	I	II	III	IV	V	VI	VII	VIII	EES	Total
Credits	19	20	24	23	25.5	20.5	19.5	12	1.5	165

Total Credits: 165

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **O:** Outside Class hours **Cat.:** Category

HSMC : Humanities and Social Sciences including Management
BSC : Basic Science Courses
ESC : Engineering Science Courses
PCC : Professional Core Courses
PEC : Professional Elective Courses
OEC : Open Elective Courses
EEC : Emerging Elective Courses
PROJ : Project Work
EES : Employability Enhancement Skills
MC : Mandatory Course

Definition of Credit:

L – Lecture	1 Hr. Lecture (L) per week	1 credit
T – Tutorial	1 Hr. Tutorial (T) per week	1 credit
P - Practical/Practice (Project and Industry based Courses)	1 Hr. Practical (P) per week	0.5 credit

18MA101	LINEAR ALGEBRA AND DIFFERENTIAL CALCULUS (COMMON TO ALL BRANCHES)	3/1/0/4
Nature of Course	J (Problem analytical)	
Pre requisites	Higher secondary mathematics	
Course Objectives:		
1	To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.	
2	To gain knowledge in using infinite series of approximations for solutions arising in mathematical modelling.	
3	To familiarize with functions of several variables applicable in many branches of engineering.	
4	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C101.1	Recall the concepts of matrices, ordinary and partial derivatives	[R]
C101.2	Express square matrix in the diagonal form and infinite series approximations	[U]
C101.3	Apply the knowledge of differential equation and extreme values of the given functions to solve the engineering problems	[Ap]
C101.4	Apply differentiation in optimization techniques.	[Ap]
C101.5	Apply the knowledge of differential equation to solve the engineering problems	[Ap]

Course Contents:

LINEAR ALGEBRA

Symmetric, Skew – symmetric and orthogonal matrices - Characteristic equation – Eigen values and eigenvectors of a real matrices and their properties (statement only) .Cayley-Hamilton theorem (statement only): Verification and application to find inverse and powers of real matrices. Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of Quadratic form to canonical form by orthogonal reduction.

SEQUENCES AND SERIES

Convergence of sequences and series – Tests of convergence of positive term series: Comparison test, D'Alembert's ratio test- Cauchy root test -Alternating Series- Leibnitz's test- Series of positive and negative terms-Absolute and conditional convergence.

CALCULUS

Functions of several variables: Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers. Ordinary differential equations-Second and Higher order linear differential equations with constant coefficients –Cauchy's and Legendre's linear differential equations- Method of variation of parameters. Application of ODE: Differential equations connected with electric circuits and Simple Harmonic motion (Differential equations and associated conditions need to be given)

	Total Hours:	**60**

Text Books:

1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 13thEdition,Pearson, Reprint,2014
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.

Reference Books:	
1	Veerarajan. T, “Engineering Mathematics I”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,”A Text book of Engineering Mathematics” 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://www.nptel.ac.in/courses/111105035
2	http://www.nptel.ac.in/courses/122104017
3	http://nptel.ac.in/courses/122102009
4	http://nptel.ac.in/courses/111107063
Online Resources:	
1	https://www.coursera.org/learn/linearalgebra2
2	https://www.coursera.org/learn/differentiation-calculus
3	https://www.coursera.org/learn/single-variable-calculus
4	https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C101.1	Remember	Classroom or Online Quiz	4
C101 .2	Understand	Class Presentation/Power point presentation	6
C101.1,2,3,4 & 5	Apply	Group Assignment & Tutorial	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA1 [10 marks]	CIA2 [10 marks]	Term End Assessment [10 marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C101.1	2	2			1		3	2						
C101.2	2	2			1		3	2		1				
C101.3	2	2			1		3	2						
C101.4	2	2			1		3	2		1				
C101.5		2			2		2	2						

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18EN102	TECHNICAL COMMUNICATION SKILLS (MECH/MCT/CIVIL/IT)	2/0/2/3
Nature of Course	:E(Theory Skill Based)	
Pre requisites	Basics of English Language	

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop communication and soft skills.
3	To facilitate learners to acquire effective technical writing skills.
4	To prepare learners for placement and competitive exams.

Course Outcomes:
Upon completion of the course, students shall have ability to

C102.1	Recall language skills for technical communication.	[U]
C102.2	Understand and communicate effectively in personal and professional situation.	[Ap]
C102.3	Apply technical writing skills to write letters, emails and prepare technical documents.	[Ap]
C102.4	Apply soft skills in corporate environment.	[Ap]
C102.5	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]

Course Contents:

Listening and Speaking

Basics of English Language - Importance of LSRW Skills - Introducing Others - **Listening** to Short Conversations or Monologues - Listening to Speeches / Talks - Listening and Responding - Identifying the Information Before Listening - Longer Listening Tasks - Recognise Functions **Speaking**- Speaking about Giving Directions / Instruction - Talk about Preferences-Agree and Disagree - Giving Opinions - Speaking Practices by Giving Examples, Reasons and Extra Information- Short Talk on Business Topics.

Reading

Reading Short Texts - Skimming and Scanning - Comparing Facts and Figures - Reading and Understanding Specific Information in a Text - Reading for Gist - Cloze Reading - Identifying Reasons and Consequences Through Reading Practices - Comprehension - Collocations.

Writing And Grammar

Writing Formal Letters (Accepting and Declining Invitations) - Writing Business Letters (Placing an Order and Complaint Letter) - Email Writing – Memo - Circular - Agenda and Minutes of the Meeting - Job Application Letter - Resume Writing - Paragraph Writing – Essay Writing-Technical Instructions and Recommendations- Jumbled Sentences - Technical Definitions - Report Phrases - Report Writing - Technical Proposal - Transcoding (Bar Chart, Flow Chart) - Note Making.

Parts of Speech- Tenses – Subject Verb Agreement - Sentence Structures - Connectives - Modal Verbs - Question Formation - If Conditionals- Active and Passive - Impersonal Passive Voice - Vocabulary Building - Business Vocabulary - Word Formation - Prefixes and Suffixes - Synonyms, Antonyms –, Abbreviations and Acronyms – Homophones and Homonyms- British and American Words - Identifying Common Errors.

Lab Components

1	Listening Comprehension	[E]
2	Pronunciation, Intonation, Stress and Rhythm	[E]
3	Common Everyday Situations: Conversations and Dialogues.	[E]
4	Formal Presentation	[E]

5	Group Discussion	[E]
6	Interview Skills	[E]
	Total Hours:	**60**

Text Books:	
1	Practical English Usage. Michael Swan. OUP. 1995.
2	Remedial English Grammar. F.T. Wood. Macmillan.2007
3	On Writing Well. William Zinsser. Harper Resource Book. 2001
4	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.
Reference Books:	
1	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
Web References:	
1	http://www.academiccourses.com/Courses/English/Business-English
2	https://steptest.in
Online Resources:	
1	https://www.coursera.org/specializations/business-english
2	http://www.academiccourses.com/Courses/English/Business-English

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	40	40	40	40	40
Apply	40	40	40	40	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C102.1	2	2			2							1		
C102.2	2	3			3							1		
C102.3	3	2			3							1		
C102.4	3	3			3							1		
C102.5	3	3			3							1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18CH101	ENGINEERING CHEMISTRY (MECH/MCT/CIVIL/IT)	3/0/3/4.5

Nature of Course	: E (Theory skill based)
Pre requisites	: NIL

Course Objectives:

1	To make the students conversant with boiler feed water, water treatment techniques.
2	To understand the principles and applications of electrochemistry and to learn electroanalytical methods.
3	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
4	To understand the concepts of photo physical and photochemical processes in spectroscopy
5	To explore the synthesis and properties of important engineering plastics, energy sources and drug molecules.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Recall the requirements of boiler feed water, water treatment procedures for industries.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[Ap]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.	[U]
C101.4	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[Ap]
C101.5	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.	[U]

Course Contents:

Water chemistry and Corrosion: Water treatment-characteristics of water-hardness-types and estimation by EDTA method. Boiler feed water–requirements-disadvantages of hard water. Boiler descaling process. Domestic water treatment-disinfection methods (chlorination, Ozonation, UV treatment)-demineralization process–desalination-reverse osmosis. Corrosion-types–mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion-protective coatings-electroplating of gold-electroless plating of nickel.

Electrochemistry and Energy sources: Electrochemical cells-electrolytic cell-reversible and irreversible cells - Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Energy Sources-Nuclear energy- reactor-breeder reactor-Photovoltaic cells-Fuel cells. Storage Devices-Batteries- alkaline-Lead acid and nickel cadmium batteries.

Polymer chemistry, Spectroscopic techniques and Synthesis of drug molecules: Introduction-monomers and polymers-classification of polymers-Polymerization-types. Mechanism of addition polymerization (free radical mechanism). Plastics-classification-preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and PET. Moulding methods-Compression moulding, Injection moulding and Blow moulding. Spectroscopy-Beer Lambert's law, principle, instrumentation and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES). Synthesis of a commonly used drug molecule-Asprin, p-nitroaniline from acetanilide.

Field work:
Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

Lab Component		
1	Estimation of hardness of water by EDTA method	[E]
2	Estimation of alkalinity of water sample	[E]
3	Determination of chloride content in given water sample	[E]
4	Estimation of dissolved oxygen in water	[E]
5	Potentiometry- determination of redox potentials and emf's	[E]
6	Conductometric titration-mixture of acids vs NaOH	[E]
7	Determination of strength of strong acid by pH metry	[E]
8	Corrosion rate of mild steel in acid medium	[E]
9	Electroplating of nickel over copper	[E]
10	Spectrophotometry-Estimation of iron in water	[E]
11	Separation of mixture of amino acids by thin layer chromatography	[E]
12	Synthesis of Nylon 66	[E]
	Total Hours:	**75**
Text Books:		
1	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2013.	
2	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane	
3	Fundamentals of Molecular Spectroscopy, by C. N. Banwell	
4	Physical Chemistry, by P. W. Atkins	
5	Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp	
6	Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan	
7	N.Krishna murthy,Vallinayagam D.,"Engineering Chemistry" PHI Learning Pvt Ltd.,2014	
8	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3rd edition PHI Learning Pvt Ltd.,2014	
Reference Books:		
1	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.	
2	Liliya.,Bazylak.I.,Gennady.E.,Zaikov.,Haghvi.A.K.,"Polymers and Polymeric Composites" CRC Press,2014.	
3	Lefrou.,Christine.,Fabry.,Pierre.,Poignet.,Jean-claude.,"Electrochemistry - The Basics, with examples" 2012 ., Springer.	
4	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.	
5	Perez, Nestor,"Electrochemistry and Corrosion Science", Springer, 2016.	
6	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.	
Web References:		
1	http://www.analyticalinstruments.in/home/index.html	
2	www.springer.com › Home › Chemistry › Electrochemistry	
3	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry	
4	www.edx.org/	
5	https://www.ntnu.edu/studies/courses	
6	www.corrosionsource.com/	

Online Resources:	
1	nptel.ac.in/courses/105104102/hardness.htm
2	https://ocw.mit.edu/courses/chemistry
3	nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com
4	- Spectroscopic technique, Colorimetry
5	https://ocw.mit.edu/courses/chemistry
6	nptel.ac.in/courses/113108051

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	30	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C101.1	3	2			1									
C101.2	3	2			1									
C101.3	3	2			1									
C101.4	3	2			1									
C101.5	3	2			1									

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18CS111	PROBLEM SOLVING USING C PROGRAMMING (Common to Civil/Mechanical/ECE/EEE)	3/0/3/4.5

Nature of Course: K (Problem Programming)

Course Objectives:

1. To understand problem solving concepts.
2. To gain knowledge about the control structures in C.
3. To write C programs using arrays, strings and pointers.
4. To learn functions, structures and unions in C.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Apply problem solving techniques to solve real world problems	[Ap]
C111.2	Understand C fundamental constructs and control structures	[U]
C111.3	Use the concept of pointers, arrays and strings in programs	[Ap]
C111.4	Develop applications using functions, structures and unions	[C]

Contents

Problem Solving Techniques: Algorithm, Pseudo-code and Flowchart Problem Solving with Sequential Logic Structure - Decisions – Loops. Case Study: Raptor and Scratch Tools.

C Fundamental Constructsand Control Structures: C Character Set – Identifiers and Keywords – Data Types – Constants - Variables and Arrays – Declarations - Operators and Expressions - Data input and output - Preparing and running a Complete C Program-Control Structures: Branching: if-else- Looping – while - do while – for - Nested control structures – switch – break – continue – comma - goto.

Arrays, Strings, Pointers, Functions, Structures and Unions: Arrays - Defining an array - Processing an array - Multi dimensional arrays - Strings: Defining a string - Null character - initialization of strings – reading and writing a string - processing the string - Pointers: fundamentals – Pointer Declaration & Usage – Dynamic Memory Allocation. Functions: Defining a Function – Accessing a function – Function Prototype Functions - Pointer to Function - Functions Returning Pointers. - Pointers and Strings - Passing arguments to a function – Recursion. Structures and Unions: The Type Definition (typedef) – Enumerated types – Structure - Type Definition – Initialization – Accessing Structures - Structures and Functions – passing Whole Structure – Self-Referential Structure - Unions.

List of Experiments:

1.	Office Automation – Resume preparation , Spreadsheet processing	[Ap]
2.	Draw Flowchart using Raptor Tool a. Simple Flow Chart b. Decision Making c. Looping[Pre test&Post test]	[Ap]
3.	Create Animation / Gaming /Application using Scratch Tool	[Ap]
4.	Program to process data types, format input and output and to evaluate an expression	[Ap]
5.	Program using decision making statements	[Ap]
6.	Program using looping statements	[Ap]
7.	Program using single and two dimensional arrays	[Ap]
8.	Program with Strings	[Ap]
9.	Program using Pointers.	[Ap]
10.	Program using Recursion	[Ap]
11.	Program using structures	[Ap]

12.	Branch specific application program	[Ap]

Text Books:

1. M. Sprankle, “Problem Solving and Programming Concepts”, 9th Edition, Pearson Education, New Delhi, 2011.
2. Byron, S. Gottfreid, “Programming with C”, McGraw Hill, Schaum’s outlines, 3rd Edition, 2014.
3. YashavantKanetkar, “Understanding Pointer in C”, 3rd Edition, BPB Publication, 2011.

Reference Books:

1. Herbert Schildt, “The Complete Reference C”, 4th Edition , McGraw Hill , 2015
2. S.ThamaraiSelvi and R.Murugesan, “Programming in ANSI C”, 6th Edition, McGraw Hill, 2012.
3. K.R.Venugopal and SudeepR.Prasad , “Mastering C”, 2nd Edition, McGraw Hill, 2015

Web References:

1. http://nptel.ac.in/courses/106105085/
2. http://nptel.ac.in/courses/106106127/
3. http://raptor.martincarlisle.com/
4. https://scratch.mit.edu/

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			Rubric Based CIA [30 Marks]	End Semester Examination [40 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	CIA3 [10 Marks]		
Remember	30	30	20	0	0
Understand	70	50	30	0	0
Apply	0	20	50	70	70
Analyse	0	0	0	0	0
Evaluate	0	0	0	0	0
Create	0	0	0	30	30

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C111.1	3	2	2								3	1		3
C111.2	3	2	2								3			3
C111.3	3	2	2					1			2			2
C111.4	3	2	2					1			1			2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME101	ENGINEERING DRAWING	2/0/2/3
Nature of Course	Practical Application	
Pre Requisites	General Drawing skill	

Course Objectives:

1	To develop skills for communication of concepts, ideas and design of engineering products.
2	To expose them to existing national standards related to technical drawings.
3	Ability to create basic geometries using the modelling software.

Course Outcomes
Upon completion of the course, students shall have ability to

C101.1	Interpret and sketch the basic and intermediate geometries.	[Ap]
C101.2	Visualize and sketch the 3D diagram from 2D diagrams.	[Ap]
C101.3	Imagine the parametric features of new products.	[C]
C101.4	Sketch the geometries using the drafting software.	[Ap]
C101.5	Interpret the isometric to orthographic projection (Vice versa)	[A]

Course Contents:

Concepts and conventions: Drafting instruments, BIS conventions, drawing sheets, general principles of projection, First angle projection – Layout of views. **(Not for examination)**

Manual drafting of the following using mini-drafter

General Plane Curves: Conic curves: ellipse, parabola and hyperbola by eccentricity method. Drawing normal and tangents to these curves, Involutes- Circle, Square, Simple Cycloid. **Orthographic projection**- Conversion of isometric/pictorial in to orthographic views.

Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. **Projection of planes-** Simple planes with inclination to any one plane. **Projection of solids-** Basic concepts using a simple prism/pyramid in vertical position and axis inclined to one of the principle planes.

Sectioning of solids- Basic concepts using a simple prism/pyramid in vertical position. **Development of lateral surfaces of solids-** Prism and pyramids. Development of lateral surfaces of truncated solids (Prism and cylinder). **Isometric drawing** of simple solids- prisms, pyramids, cylinder and cone.

Lab Components

S. No	List of Experiments	CO Mapping	RBT
1.	Study the Basics of 2D and 3D modelling	C101.4	[R]
2.	Drafting of title block, Co-ordinate system	C101.4	[U]
3.	Drafting of simple geometrics: Line, planes and simple 2D drawings- Three exercises	C101.4	[A]

Total Hours: 60

Text Books:

1.	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
2.	Varghese P. I., “Engineering Drawing”, McGraw Hill Education Pvt. Ltd., 2015.

3.	Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2010.
4.	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2010.
Reference Books:	
1.	Bhatt N.D and Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.
2.	Venugopal K. and Prabhu Raja V, “Engineering Graphics”, New Age Int. (P) Limited, 2011.
Web References:	
1.	http://nptel.ac.in/courses/112103019/Engineering drawing
2.	http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	10	0	10	20	10
Understand	20	10	10	30	10
Apply	40	40	30	50	40
Analyse	30	40	40	0	40
Evaluate	0	10	10	0	0
Create	0	0	0	0	0

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C101.1	3			3			2		3			2		
C101.2	3			2			3		2		3	3	1	
C101.3	2		2				3		3		2	2		
C101.4	3		2				3		3		3	3	1	
C101.5	3						3		3		3			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MC101	MANDATORY COURSE I	1/0/0/0
Nature of Course	: Induction Program	
Pre requisites	: Nil	

Course Objectives:

1	To have broad understanding of society and relationships
2	To nurture the character and fulfil one's responsibility as an engineer, a citizen and a human being
3	To incorporate meta skills and values

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Explore academic interest and activities	[Ap]
C101.2	Work for excellence	[Ap]
C101.3	Promote bonding and give a broader view of life and character	[Ap]

Course Contents:

PHYSICAL ACTIVITY
Yoga

CREATIVE ARTS (students can select any one of their choice)
Painting, sculpture, pottery, music, dance, craft making and so on

UNIVERSAL HUMAN VALUES
Enhancing soft skills

LITERARY AND PROFICIENCY MODULES
Reading, writing, speaking – debate, role play etc.
Communication and computer skills

LECTURES BY EMINENT PEOPLE
Guest lecture by subject experts

VISIT TO LOCAL AREAS
Meditation centre/orphanage/Hospital

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION
Lectures by Department's Head and senior faculty members

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C101.1				2		2		2	3	2				
C101.2				3		3		2	3	2				
C101.3				3		1		2	3	2				

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MA201	INTEGRAL CALCULUS AND COMPLEX VARIABLES (COMMON TO ALL BRANCHES)	3/1/0/4
Nature of Course	J (Problem analytical)	
Pre requisites	Higher secondary mathematics	

Course Objectives:

1	To gain knowledge in improper integrals, Gamma and Beta functions which are needed in engineering applications
2	To develop logical thinking and analytical skills in evaluating multiple integrals
3	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines
4	To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Recall basic integration formulae, scalar and vector point function concepts	[R]
C201.2	Identify the concepts of integrals in computing Beta and Gamma functions	[U]
C201.3	Apply the concepts of the integration in evaluating engineering problems related to area, volume and vector point functions.	[Ap]
C201.4	Find the derivatives of the complex valued functions	[Ap]
C201.5	Apply the concepts of complex integration in communications, testing and verification in engineering.	[Ap]

Course Contents:

INTEGRAL CALCULUS

Definite integrals - Evaluation of definite integrals using Bernoulli's formula. Beta and Gamma functions: Relation between Beta and Gamma Functions - Evaluation of Integrals using Beta and Gamma Functions. Multiple integrals : Double integration in Cartesian coordinates –Area as double integral – Change the order of integration-Triple integration in Cartesian co-ordinates –Volume as triple integral

VECTOR CALCULUS

Vector differential operator- Gradient of a scalar point function - Directional derivatives – Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields – Simple problems– Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem(theorem statements only)– Simple applications involving cubes and rectangular parallelopipeds.

COMPLEX VARIABLE

Complex differentiation: Analytic Functions - Cauchy-Riemann equations (excluding proof) – Harmonic functions- Conjugate harmonic functions – Construction of analytic functions – Conformal mapping. Transformation: w = c+z,cz,1/z and Bilinear transformation. Complex integration: Cauchy's Integral theorem (statement)- Cauchy's Integral formula - Laurent's series-Zeros and singularities – Residues – Cauchy's Residue theorem (statement). Contour integration: Evaluation of real integrals of the form $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta$ and $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} dx$

Total Hours:	**60**

Text Books:	
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 13th Edition, Pearson, Reprint,2014.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.
Reference Books:	
1	Veerarajan. T, "Engineering Mathematics II",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.Manish Goyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=122107037
2	http://nptel.ac.in/courses/122107036/
3	http://nptel.ac.in/video.php?subjectId=117102060
Online Resources:	
1	https://www.coursera.org/learn/pre-calculus
2	https://www.coursera.org/learn/linearalgebra1
3	https://alison.com/courses/Advanced-Mathematics-1
4	https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Remember	Classroom or Online Quiz	4
C201.2	Understand	Class Presentation/Power point presentation	6
C201.1,2,3,4 & 5	Apply	Group Assignment & Tutorial	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)														
COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C201.1	2	2			1		3	2				1		
C201.2	2	2			1		3	2		1		1		
C201.3	2	2			1		3	2				1		
C201.4	2	2			1		3	2		1		1		
C201.5		2			2		2	2				1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME201	ENGINEERING MECHANICS	3/1/0/4
Nature of Course	Concepts and Analytical	
Pre requisites	Fundamentals of Basic mathematics and physics	

Course Objectives:

1	To make the students understand the vector and scalar representation of forces and moments and the static equilibrium of particles and rigid bodies.
2	To understand the effect of friction on equilibrium, laws of motion, kinematics of motion and their interrelationship.
3	To make the students understand the properties of surfaces and solids, prediction of behaviour of particles and rigid bodies under motion.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Define and illustrate the basic concepts of force system	[U]
C201.2	Calculate the resultant force, moment and geometrical properties of 2D, 3D objects	[Ap]
C201.3	Analyse the resistance force of particles and objects for Impending Motion	[A]
C201.4	Determine the displacement, velocity and acceleration of particles and objects.	[Ap]

Course Contents:

Equilibrium of Particles and Rigid Bodies

Force Systems – Basic concepts, System of Forces, Coplanar Concurrent Forces, Resolution and addition of forces, resultant of several concurrent forces, Forces in space, Particle equilibrium in 2D and 3D. Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems - Equations of equilibrium of rigid bodies in 2D and 3D. Beams and frames - types of supports, loads and reactions.

Centre of Gravity, Moment of Inertia and Friction

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere.

Friction: Types of friction, Limiting friction, Laws of friction – Static and Dynamic Friction; simple contact friction, ladder friction – wedge friction – screw jack.

Dynamics of Particles and rigid bodies

Kinematics of Particles: Basic terms, general principles in dynamics; Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates); Relative motion.

Kinetics of Particles: Newton's 2nd law (rectangular, path, and polar coordinates). D'Alembert's principle and its applications; Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Kinetics of rigid bodies: rigid body translation, rotation and general plane motion.

Total Hours:	**60**

Text Books:	
1	Beer F.P, and Johnston ER, Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill Education, New Delhi, 2015.
2	Dhiman A.K, Dhiman P, Kulshreshtha D.C, Engineering Mechanics-Statics and Dynamics, McGraw Hill Education, 2015
Reference Books:	
1	Kottiswaran N, Engineering Mechanics - Statics and Dynamics, Sri Balaji Publications- 2013.
2	Rajasekaran S and Sankarasubramanian G, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2009.
3	Meriam JL and Craige, "Engineering Mechanics statics and dynamics", John Willey and Son's publication 8th edition.2011
4	Kumar DS, "Engineering Mechanics", S.K.Kataria& Sons Publications-2012.
5	Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2011.
6	Timoshenko.S, "Engineering Mechanics", McGraw Hill Education, 2008.
Web References:	
1	http://nptel.ac.in/courses/122104015/
2	http://nptel.ac.in/courses/112103109/
Online Resources:	
1	https://ocw.mit.edu/courses

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Understand	Objective type Quiz	5
C201.2	Apply	Assignment	5
C201.3	Analyze	Assignment	5
C201.4	Apply	Tutorial	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	
Remember	-	-	-	-
Understand	20	20	30	30
Apply	50	40	40	40
Analyse	30	40	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C201.1	2	3	1									1		1
C201.2			2		3							1		2
C201.3	2	1	3	2	3			3	2		1	2		1
C201.4			3		3		2	3	2		1	2		1

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18PH201	ENGINEERING PHYSICS (MECH/MCT/CIVIL)	3/0/3/4.5
Nature of Course	: E (Theory skill based)	
Pre requisites	: Nil	

Course Objectives:

1	To learn the basic concepts of physics needed for all branches of engineering
2	To apply the physics concepts in solving real time engineering problems
3	To implement and visualize theoretical aspects in the laboratory
4	To familiarize the students to handle various instruments and equipment

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Outline the principle and working of various instruments	[U]
C201.2	Describe the basic concepts of simple harmonic, damped oscillations and lasers	[U]
C201.3	Discuss the thermal properties of materials & its applications	[U]
C201.4	Recall the basic concepts of crystal structure of the various materials	[R]
C201.5	Solve complex problems in everyday life using the knowledge gained from the course	[Ap]
C201.6	Practice to solve problems using theoretical knowledge as a team	[Ap]

Course Contents:

Instrumentation:

Instrumentations: dial gauge, piezo electric strain gauge, load cell (pneumatic and hydraulic load cell), venturimeter, thermocouple, tachometer (AC and DC), stroboscope ,cathode ray oscilloscope (CRO – working mechanism),digital storage oscilloscope (DSO), Pirani gauge, scintillation counter, optical microscope, scanning electron microscope (SEM), transmission electron microscope (TEM) - Types of errors: gross error, systematic error and random error.

Harmonic Oscillations and Laser

Harmonic Oscillations: Periodic motion-Simple harmonic motion-characteristics of simple harmonic motion-Vibration of simple spring mass system. Resonance-Definition - Damped harmonic oscillator, energy decay in a damped harmonic oscillator. **Laser:** Einstein's theory of matter radiation interaction and A and B coefficients - Amplification of light by population inversion - Different types of lasers: CO_2 and Neodymium lasers - Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in engineering: welding, drilling and cutting.

Thermal properties and Crystallography

Thermal properties: Thermal conductivity – Definition – Derivation of 'K' - Co-efficient of thermal expansion, heat capacity, thermal conduction mechanisms and thermal stresses - Applications: Bimetallic strip, thermal insulation, tempered glass, ceramic-to-metal joints, cryogenic materials. **Crystallography:** crystal system, bravais lattice, atomic packing factor for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structured – Miller indices – Crystal imperfections : point, line burger vector

Lab Component

1	Laser and optical fiber parameters	[U]
2	Wavelength measurement of mercury spectrum- Spectrometer Grating	[U]
3	Young's modulus - Non- Uniform bending method	[U]
4	Rigidity modulus – Torsional Pendulum	[U]
5	Coefficient of viscosity for a liquid –Poiseuille's method	[U]
6	Magnetic field along the axis of current carrying coil- Stewart and Gee method.	[U]

7	LCR circuits.	[U]
8	Newton's ring- wavelength of sodium vapour lamp / Airwedge – Thickness of thin sample	[U]
9	Time constant of RC circuits.	[U]
10	Transverse and longitudinal wave modes- Melde's experiment.	[U]
	Total Hours:	**75**
Text Books:		
1	Rajendran, V 'Engineering Physics' Mc Graw Hill Publications ltd, New Delhi, 2014.	
2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2010	
Reference Books:		
1	M.N. Avadhanulu, P.G. Kshirshagar – A Text Book of Engineering Physics- S.Chand & Co Ltd, 2016.	
2	A.K. Sawney, Puneet Sawhney " A Course in Mechanical Measurements and Instruments" – Dhanpat Rai & company 2001	
3	The Feynman Lectures on Physics, Vol. I: The New Millennium Edition.2010	
Web References:		
1	http://faculty.sites.uci.edu/chem1l/files/2013/11/RDGerroranal.pdf	
2	http://nptel.ac.in/downloads/112104158/	
3	http://nptel.ac.in/courses/113106032/13%20-%20Thermal%20Property.pdf	
4	http://www.feynmanlectures.caltech.edu/info/	
5	https://books.google.co.in/books?id=Vbk3BQAAQBAJ&printsec=frontcover&dq=physics-oscillators&hl=ta&sa=X&ved=0ahUKEwj77JSyg8LbAhVJQ48KHc-RDu8Q6AEIJjAA#v=onepage&q=physics-oscillators&f=false	
6	http://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf	
7	https://www.drdo.gov.in/drdo/data/Laser%20and%20its%20Applications.pdf	
8	https://physics.info/sho/	
9	https://web.iit.edu/.../web/.../Academic%20Resource%20Center/.../Miller...	
10	http://www.phys.ufl.edu/courses/phy2054/s09/lectures/2054_ch21A.pdf	
Online Resources:		
1	https://www.patana.ac.th/secondary/science/anrophysics/ntopic4/commentary.htm	
2	http://www.indiaeducation.net/	
3	https://learndigital.withgoogle.com/digitalunlocked?gclid=EAIaIQobChMIuty_34nC2wIVGQ4rCh0o2AelEAAYASAAEgKeUvD_BwE&dclid=CKPjlfWJwtsCFQMZjgodEPgKBg	
4	https://www.jic.ac.uk/microscopy/links.html	
5	http://esiksha.com/home.asp	
6	www.fiberopticsonline.com/	
7	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/	

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**Term End Examination [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	20	30	20	30
Understand	60	60	60	40	60
Apply	10	20	10	30	10
Analyse	-	-	-	10	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C201.1	2	1			3									
C201.2	2	1			2									
C201.3	2	1			2									
C201.4	1				2							1		
C201.5	3	2	1		3							2		
C201.6	3	2	1		2							2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18EE211	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (COMMON TO MECH, CIVIL AND IT)	3/0/3/4.5

Nature of Course : G (Theory analytical)

Course Objectives:

1	To equip students with a basic understanding of Electrical circuits
2	To learn the working principle of transformers
3	To understand the DC and AC Machine working principles and to have a knowledge on selection of machine for specific types of applications.
4	To give a comprehensive exposure to electrical installations.
5	To equip students with an ability to understand basics of analog and digital electronics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C211.1	Analyze the concepts in ac circuit and dc circuits.	[A]
C211.2	Understand the working principle of single phase and three phase transformers.	[U]
C211.3	Understand the working principle of DC and AC machines.	[U]
C211.4	Utilize the basic components for electrical installations.	[Ap]
C211.5	Understand the basic concepts of Analog and Digital Electronics.	[U]

Course Contents:

DC Circuits and AC Circuits: DC Circuits-Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage law, analysis of simple circuits with dc excitation, Mesh, Nodal Analysis Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits with DC excitation.AC Circuits-Representation of sinusoidal waveforms, peak and rms values, Phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

Electrical Machines and Installations: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections (Qualitative only). Construction and working principle of DC motor. Construction and working principle of Synchronous motor and three phase Induction motor. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption.

Basics of Analog and Digital Electronics: Semiconductor, PN junction diode, Zener diode, rectifier- Half wave, full wave and Bridge rectifier, Introduction to Number system, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.

Lab Component		**CO Mapping**	**Bloom's Taxonomy**
1.	Familiarization of Electrical Elements, Sources, Measuring Devices and Verification of ohm's law	C211.1	[R]
2.	Estimation of voltage and current by KVL and KCL in Electric Circuits	C211.1	[U]
3.	Determination of mesh current and node voltage by Mesh and Nodal Analysis	C211.1	[U]
4.	Application of Superposition theorems, thevenin's and maximum power transfer theorem in electrical circuits	C211.1	[Ap]
5.	Measurement of three phase power	C211.2	[A]
6.	Demonstration of cut-out sections of machines: dc machine (Commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine	C211.3	[U]

	(field winding - slip ring arrangement) and single-phase induction machine		
7.	Load test on dc shunt motor.	C211.3	[Ap]
8.	Demonstration of components of LT Switch Gears	C211.4	[U]
9.	Construction of bridge rectifier with and without filters	C211.5	[U]
10.	Verification of logic gates.	C211.5	[R]
			Total Hours: 75

Text Books:	
1	Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 6th edition 2015.
2	Vincent. Del. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd edition, 2015.
3	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th edition, 2011
4	Donald .A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition reprint,Tata Mc GrawHill, 2013.
5	M. Morris Mano, 'Digital Logic and Computer Design', Prentice Hall of India, 5th edition, 2013
Reference Books:	
1	Charles A.Gross, Thaddeus A.Roppel, "Fundamentals of Electrical Engineering", CRC press, 2012.
2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 5th edition 2011,
3	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education,6th edition, 2013.
Web References:	
1	http://nptel.ac.in/course.php?disciplineId=108
2	https://ocw.mit.edu/courses/find-by topic/#cat=engineering&subcat=electricalengineering&spec=electricpower
3	https://nptel.ac.in/video.php?subjectId=117103063
4	https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
5	https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
Online Resources:	
1	http://www.electrical-knowhow.com/
2	https://www.edx.org/course/electricity-magnetism-part-1-ricex-phys102-1x-1
3	https://www.mooc-list.com/course/fundamentals-electrical-engineering-coursera
4	https://nptel.ac.in/course.php

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Rubrics Based Practical Assessment [30 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	Term End Examination [10 Marks]		
Remember	50	50	40	40	40
Understand	50	50	40	40	40
Apply	-	-	20	20	20
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C211.1	2	3	1	1	2					1		1		
C211.2	2	1	0	0	1					2				
C211.3	2	1	0	0	1					2				3
C211.4	3	2	1	1	2					3		1		3
C211.5	2	1	0	0	1					3				3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME102	ENGINEERING PRACTICES LABORATORY	1/0/4/3

Nature of Course: M (Practical application)

Co Requisites: Nil

Course Objectives:

1. To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2. To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets, their working and trouble shooting.

Course Outcomes

C102.1	Identify and solve the basic engineering problems at home and in workplace	[Ap]
C102.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C102.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[Ap]
C102.4	Prepare pipe connections and sand moulds.	[Ap]
C102.5	Understand the fundamentals of machining.	[U]
C102.6	Examine and troubleshoot electrical and electronic circuits.	[A]

Course Content:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods –Sheet metal operations - Welding - arc welding , gas welding , TIG & MIG welding — basic machining using lathe - metal casting - Carpentry work using power tools - Plumbing components and pipelines

List of Experiments:

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of butt joints and lap joints using arc welding and TIG / MIG welding.	C102.3	[Ap]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C102.2	[Ap]
3	Preparation of wooden joints by sawing, planning and cutting.	C102.3	[Ap]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C102.4	[Ap]
5	Basic machining - simple turning operations.	C102.5	[U]
6	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C102.4	[Ap]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipments: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder.

S.No	List of Experiments	CO Mapping	RBT
1	Study and identification of electronic components with specification.	C102.6	[A]
2	Testing of CRO and Electronic components using Multimeter.	C102.6	[A]
3	Generation and measurement of signals using CRO.	C102.6	[A]

4	Familiarisation of digital basic gate IC's.	C102.6	[A]
5	Soldering practice-components devices and circuits- using general purpose PCB.	C102.6	[A]
6	Demonstration of meters and electrical components.	C102.6	[A]
7	Safety precautions with electrical components.	C102.6	[A]
8	Residential house wiring.	C102.6	[A]
9	Measurement of power and energy.	C102.6	[A]
10	Trouble shooting of electrical equipments.	C102.6	[A]
		Total Hours	45

Reference Books:

1. SeropeKalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2. Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014.
3. Suyambazhagan S, 'Engineering practices' PHI Learning private limited, New Delhi,2012.
4. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Web References:

1. www.nptel.ac.in
2. www.sme.org
3. http://www.allaboutcircuits.com/education/

Blooms Taxonomy based Assessment Pattern:

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	10	10
Understand	10	10
Apply	40	40
Analyze	20	20
Evaluate	10	10
Create	10	10

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C102.1	3	3	3		3		3		3	2		1	3	1
C102.2	3	3	3		3		3		3	2		1	3	1
C102.3	2	1	3	2	3			3	2		1	1		1
C102.4														
C102.5														
C102.6														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MC201	ENVIRONMENTAL SCIENCES	2/0/0/0
Nature of Course	C (Theory Concept)	
Pre requisites	Basics in Environmental Studies	

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C201.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C201.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C201.4	Apply the gained knowledge to overcome pollution problems.	[Ap]
C201.5	Apply the gained knowledge in various environmental issues and sustainable development.	[Ap]

Course Contents:

Natural Resources:
Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification – Role of an individual in conservation of natural resources.

Environmental Pollutions:
Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Greenhouse effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedyb. Water pollution c. Soil pollution - Solid waste management-Recycling of plastics-Pyrolysis method-causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Social issues and the Environment:
Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard.

Total Hours: 30

Text Books:

1	AnubhaKaushik and C P Kaushik “Perspectives in Environmental Studies”4th Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.

Reference Books:

1	Tyler Miller, Jr., “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13th Edition, McGraw Hill, 2015.
3	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Third Edition, Pearson Education, 2014.

Web References:	
1	http://nptel.ac.in/courses/104103020/20
2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
4	http://nptel.ac.in/courses/120108004/
5	http://nptel.ac.in/courses/122102006/20
Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Remember	Quiz	**5**
C201.2	Understand	Writing Skills	**5**
C201.3	Understand	Class Presentation	**5**
C201.4 & 5	Apply	Group Assignment	**5**

Summative assessment based on Continuous Assessment

Bloom's Level	Continuous Assessment		
	CIA-I [25 marks]	CIA-II [25 marks]	Term End Assessment [30 marks]
Remember	20	40	20
Understand	60	50	60
Apply	20	10	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C201.1	3		1		1	1								
C201.2	3		1		1	1								
C201.3	3		1		1	1								
C201.4	3		1		1	1								
C201.5	3		1		1	1								

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MA303	FOURIER SERIES, CURVE FITTING AND PARTIAL DIFFERENTIAL EQUATIONS	3/1/0/4

Nature of Course	Problem analytical
Pre requisites	Higher secondary mathematics

Course Objectives:

1	To understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data
2	To learn the concept of curve fitting
3	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation
4	To solve boundary value problems encountered in engineering practices using Fourier series
5	To find numerical solution for partial differential equations

Course Outcomes:
Upon completion of the course, students shall have ability to

C303.1	Recall basic integration concepts and partial derivatives	[R]
C303.2	Formulate and solve the partial differential equations	[U]
C303.3	Interpret Fourier series solutions to the engineering problems	[Ap]
C303.4	Apply analytical methods to solve wave and heat equation with boundary conditions	[Ap]
C303.5	Apply numerical methods to solve wave and heat equation with boundary conditions	[Ap]

Course Contents:

Fourier series: Dirichlet's conditions - General Fourier Series : Problems under $(0,2\pi)$- Problems under $(0,2l)$ - Odd and Even Functions : Problems under $(-\pi,\pi)$ - Problems under $(-l,l)$ - Half range sine series and cosine series - Parseval's Identity - Harmonic analysis

Curve Fitting : Linear law - Laws reducible to Linear law- Method of group averages - straight line and parabola - Principle of Least squares - Fitting a straight line by the method of Least squares - Fitting a parabola- - Fitting an exponential curve

Partial Differential Equations -Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions- Lagrange's linear equations-Linear homogeneous partial differential equations of second and higher order with constant coefficients- **Applications of Partial Differential Equations -**Classifications-One dimensional wave equation-One dimensional heat equation-Two dimensional heat equation- **Numerical Solution to PDE-** Elliptic equations- Parabolic Equations (one dimensional heat) - Hyperbolic Equations(one dimensional wave).

Total Hours:	**60**

Text Books:

1	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014
2	Grewal. B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2017.
3	Rajasekaran S., "Numerical methods in Science and Engineering – A Practical Approach", 3rd edition, S.Chand, 2017.

Reference Books:

1	Veerarajan. T, "Transforms and Partial differential equations", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., reprint, 2016.

2	N.P.Bali ,"A Text book of Engineering Mathematics Sem-III/IV" 13th edition, Laxmi publications ltd, 2017.
3	Glyn James, —"Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2016.
4	P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Numerical Methods",S.Chand Co. Ltd., New Delhi, 2003.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=122107037
2	http://nptel.ac.in/courses/122107036/
3	http://nptel.ac.in/video.php?subjectId=117102060
Online Resources:	
1	https://www.edx.org/course/calculo-diferencial-galileox-cmath001rx
2	https://www.edx.org/course/pre-university-calculus-delftx-calc001x-1
3	https://www.edx.org/course/calculus-1a-differentiation-mitx-18-01-1x
4	https://alison.com/courses/Advanced-Mathematics-1
5	https://ocw.mit.edu/courses/.../18-335j-introduction-to-numerical-methods-fall-2010/ocw.usu.edu › Electrical and Computer Engineering › Signals and Systems

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C303.1	Remember	Classroom or Online Quiz	4
C303.2	Understand	Tutorial	6
C303.3	Apply	Group Assignment	4
C303.4 & C303.5	Apply	Group activities	6

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C303.1	1	1			2							1		
C303.2	2	2			2							1		
C303.3	3	3			3							1		
C303.4	3	3			2							1		
C303.5	3	3			2							1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME301	STRENGTH OF MATERIALS	3/1/0/4
Nature of Course	Theory Analytical	
Pre Requisites	Engineering Mechanics	

Course Objectives:

1	To learn the fundamental concepts of strength of materials
2	To understand and analyze the stress induced in various structural members
3	To evaluate the stability of columns and beams.
4	To understand the strain energy and two dimensional stresses.

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Understand and analyse the strength of various structural elements subjected to axial loading.	[A]
C301.2	Analyse the effect of transverse loading on beams.	[A]
C301.3	Discover the stresses in shafts.	[Ap]
C301.4	Inspect the stability of structural elements.	[A]
C301.5	Analyze the effect of two dimensional stresses and strain energy on materials.	[A]

Course Contents:

Simple Stresses and Strain: Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams, factor of safety, Elongation due to self-weight, Compound bars, Thermal stresses, Compound section subjected to thermal stresses, Elastic constants and their relationship. **Shear Force and Bending Moment in Beams**: Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying load and their combinations.

Stresses in Beams: Introduction, pure bending theory, Assumptions, derivation of bending equation, section modulus, flexural rigidity. Analysis of bending stress in be distribution diagrams for circular, rectangular, 'I' sections. **Torsion in Circular Shaft:** Introduction, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, stepped and compound shaft.

Columns and Struts: Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns. **Deflection of Beams:** Double Integration method and Macaulay's method. **Two dimensional Stresses:** Analysis of Stresses in thin shells Stresses on inclined planes, Principal stresses and Principal planes, Mohr's circle method. **Strain Energy**: Analysis of strain energy in uniaxial loading.

Total Hours:	**60**

Text Books:

1	Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
2	S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)

Reference Books:

1	Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007
2	B.S. Basavarajaiah, P.Mahadevappa "Strength of Materials" in SI Units, University Press (India) Pvt. Ltd., 3rd Edition, 2010.
3	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2017

Web References:

1	https://lecturenotes.in/subject/260/strength-of-materials-som

Online Resources:	
1	https://nptel.ac.in/courses/112107146

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C301.1	Analyze	Group Assignment	5
C301.2		Tutorials	10
C301.5			
C301.3	Apply	Individual Assignment / Case Study	5
C301.5			

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	20	10	10	10
Apply	20	30	30	30
Analyse	50	50	50	50
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C301.1	3	3	3		3				2			3		
C301.2	3	3	3		3				2			3		
C301.3	3	3	3		3				2			3		
C301.4	3	3	3		3				2			3		
C301.5	3	3	3		3				2			3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME302	ENGINEERING THERMODYNAMICS	3/1/0/4
Nature of Course	Theory concepts	
Pre requisites	Fundamentals of Basic Mathematics	

Course Objectives:

1	To understand the thermodynamic laws and their applications.
2	To study the properties of steam and the use of steam tables and Mollier Chart.
3	To develop a clear understanding about thermodynamic relations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C302.1	Discuss about the thermodynamic properties, work, heat and entropy.	[U]
C302.2	Apply the laws of thermodynamics to boilers, refrigerators, heat engines, compressors and nozzles.	[Ap]
C302.3	Determine the properties of gas mixtures and thermodynamic relations.	[A]
C302.4	Calculate and compare the performance of boilers and refrigerators.	[A]

Course Contents:

Basic Concepts and First Law: Review of basic concepts of thermodynamics- System, Surrounding, Property, State and Equilibrium, Process and Cycle, Work, Temperature, Heat and Other forms of energy, Internal energy, Specific heat capacities, Macroscopic approach and Microscopic approach - Quasi static process, Zeroth law of thermodynamics, First law of thermodynamics, Application of First law to non- flow system, Steady flow energy equation and its application to various thermal equipments, Unsteady flow process-Tank filling and emptying (Descriptive). **Second Law:** Second law of Thermodynamics – Kelvin's and Clausius statements of Second law, Reversibility and Irreversibility, Heat reservoirs - Refrigerator and heat pump, Carnot theorem, Carnot cycle, Reversed Carnot cycle, Efficiency, COP, Thermodynamic temperature scale, Clausius inequality, Concept of entropy, Entropy of ideal gas, and Principle of increase of entropy.

Properties of Pure Substance and Vapour Power Cycle: Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, Phase rule, P-V, P-T, T-V, T-S, H-S (Mollier chart) diagrams, PVT surfaces, Specific properties of steam - Use of Steam Tables & Mollier chart, Calculations of work done and heat transfer in non-flow and flow processes, Standard Rankine cycle (Analytical), Reheat (Descriptive) and Regenerative cycle (Descriptive).

Gas Mixtures and Thermodynamic Relations: Gas mixtures – Properties of ideal and real gases, Equation state, Vander waal's equation of state, Compressibility factor, Compressibility chart, Dalton's law of partial pressure, Exact differentials, TdS relations, Maxwell's relations, Clausius clapeyron equations, Joule–Thomson coefficient. **Refrigeration:** Refrigeration – definition - terminology used, desirable properties of refrigerant, classification of refrigerants, selection of refrigerant, types of refrigeration systems, Ideal vapour compression refrigeration cycle (Descriptive), Vapour absorption refrigeration cycle (Descriptive).

Total Hours:	**60**

Text Books:

1	Nag. P.K, "Engineering Thermodynamics", 5th Edition, McGraw Hill Education, New Delhi, 2017.
2	Yunus. N.J, Cengel. A and Michael Boles. A, "Thermodynamics- An Engineering Approach" 8th Edition, McGraw Hill Education, New Delhi, 2016.

Reference Books:	
1	Mahesh M. Rathore, “Thermal Engineering”, Mc Graw Hill Education private limited, Reprint 2016.
2	Michael Moran.J, and Howard Shapiro.N, “Fundamentals of Engineering Thermodynamics”, 4th Edition, John Wiley & Sons, New York, 2017.
Web References:	
1	http://nptel.ac.in/courses/112103016/
2	http://nptel.ac.in/courses/112105128/
Online Resources:	
1	http://booksite.elsevier.com/balmer/thermodynamicresources.php

Tentative Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C302.1	Understand	Online Quiz	**5**
C302.2	Apply	Assignment	**5**
C302.3	Analyze	Group Assignment	**5**
C302.4	Analyze	Case Study	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA-III [10 Marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	30	30	30	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C302.1	3	3			3				3		2	1		
C302.2		2										2		
C302.3	2				3			2		2		3		
C302.4	3	3			3					2		3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME303	MANUFACTURING TECHNOLOGY – I (WITH LAB)	3/0/2/4

Nature of Course	Theory concepts and lab
Pre Requisites	Fundamentals of Physics and Chemistry

Course Objectives:

1	To make the students understand the various manufacturing processes available to produce the desired components
2	To impart the methodologies to be followed in casting, fabrication and forming of engineering materials
3	To enable the students to select a particular manufacturing process for the required product based on its process characteristics

Course Outcomes:
Upon completion of the course, students shall have the ability to

C303.1	Understand the concepts of basic manufacturing processes like casting, welding, forming and plastic moulding.	[U]
C303.2	Analyse the suitability and the potential application of the manufacturing process through its process characteristics.	[A]
C303.3	Explore the possible defects and its causes in various manufacturing processes.	[Ap]
C303.4	Compare the characteristics of various manufacturing process.	[Ap]

Course Contents:

METAL CASTING PROCESSES: Sand casting – Patterns – types and allowances -Green and dry sand casting process- Types of Moulding sand – Properties, Cores and its types – Core prints, Riser and gating design, Moulding Machines, Special molding processes – Carbon dioxide molding process, Investment casting processes – Die casting processes – Non-ferrous metals, Shell molding processes – Mechanism of solidification – Finishing of castings – Casting defects – causes and remedies.

METAL JOINING AND METAL FORMING : Welding – classification, Arc welding processes – Gas welding processes and equipments**,** TIG welding & Submerged arc welding, Resistance welding – working principle of spot, seam and projection welding, Plasma arc welding, Thermit welding, Electron beam and friction welding, Weld defects, Soldering and brazing – Metal forming – Elastic and Plastic deformation – Hot and cold working – Open and close die forging – Rolling mills, Thread and ring rolling – Extrusion and Wire tube drawing , Tube bending, CNC rolling Process – Defects in rolled parts.

SHEET METAL WORKING AND MANUFACTURING OF PLASTIC COMPONENTS: Sheet metal characteristics – Shearing operations – Stretch forming operations – Formability of sheet metal - Special forming processes Hydro forming, Electro hydraulic forming – Rubber pad forming - Metal spinning, Explosive forming, Magnetic pulse forming – Peen forming – Load estimation for sheet metal forming processes – Introduction and types of plastics – Moulding of thermo plastics – Working principles and typical applications of injection moulding – Introduction to blow moulding, Rotational moulding – Extrusion, Thermo forming – Compression moulding – Sheet moulding compound, Transfer moulding , 3D Printing.

Total Number of Theory Hours	**45**

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Study the Basics of gas welding, arc welding, TIG and MIG Welding process.	C301.1	[R]
2	Joining of plates using Vertical up and down welding process	C301.2	[Ap]
3	Joining of plates using Overhead welding process.	C301.2	[Ap]

4	Welding of plates using TIG and MIG Welding process	C301.2	[Ap]
5	Manufacture a plastic component using injection moulding process	C301.2	[Ap]
6	Study the basics of sand mould and analyse the defects.	C301.3	[A]
7	Preparation of a sand mould using split pattern	C301.2	[Ap]
8	Preparation of a sand mould using solid pattern	C301.2	[Ap]
9	Industrial visit to four manufacturing centers on activity working day.	C301.2	[Ap]

Text Books:

1	Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Seventh edition, 2018.
2	P. N. Rao, "Manufacturing Technology", Vol.1, McGraw-Hill Education, 2013.

Reference Books:

1	Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014
2	P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, Eighth Revised edition, 2014
3	Radhakrishnan, "Manufacturing Technology I", Scitech Publications Pvt Ltd, 2010

Web References:

1	www.nptel.ac.in
2	www.sme.org
3	https://www.coursera.org/learn/3d-printing-revolution

Online Resources:

1	https://ocw.mit.edu/courses

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	20	20	10	20	20
Understand	50	50	50	20	50
Apply	20	20	30	60	20
Analyse	10	10	10	-	10
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C303.1	3	3	3		3		3		3	2		1	3	
C303.2	3	3	2		3		3		3	2				
C303.3	3	3	3		3		3		3	2		1	3	
C303.4	3	3	3		3		3		3	2		1	3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME304	METALLURGY AND MATERIALS TESTING (WITH LAB)	3/0/2/4

Nature of Course	Theory concepts and Lab
Pre Requisites	Engineering Physics

Course Objectives:

1	To impart knowledge on phase diagrams and use of phase diagrams
2	To understand the heat treatment processes and applies the same to modify the materials properties.
3	To impart knowledge on various metals and non-metals and its applications
4	To demonstrate the various testing of materials.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Recall the different types of materials, structure of materials and their properties.	[R]
C304.2	Understand the phase diagrams and the use of phase diagrams.	[U]
C304.3	Identify and analyse the heat treatment processes and coatings to modify the properties of materials.	[A]
C304.4	Implement the various testing procedures to study the properties of materials.	[Ap].

Course Contents:

Structure of solids and phase diagrams: Classification of solids – characteristics of covalent solids, ionic solids and metallic solids – crystal structure in metals – BCC, FCC and HCP – crystal defects – point, line and surface – structure of solid solutions - Phase diagrams- cooling curves- phase rule- lever rule – application of phase rule and lever rule in Cu-Ni phase diagram - Iron and carbon phase diagram – phases and reactions in iron-carbon diagram.

Heat treatment of steel: Definition – purposes – types - annealing, normalising, hardening and tempering of steel – TTT diagram for eutectoid steel – continuous cooling curve and interpretation of final microstructure – austempering and mar tempering - surface modification - case hardening - carburising, nitriding, carbonitriding, flame, induction, electron beam and laser beam hardening- coating - PVD process using plasma - **Metals and non-metals: Metals:** properties and applications of carbon steel, alloy steel (stainless steel, HSLA steel) - specification of steels - microstructure, properties and application of different cast iron – properties and applications of nickel, copper, titanium and aluminium alloys - precipitation hardening – **Non-metals:** Polymers - Thermoplastics and thermosets, properties and applications (Acrylonitrile butadiene styrene, polyamide, polyphenyleneoxide, polyetheretherketone, urea formaldehyde, phenol formaldehyde and epoxy) –Ceramics - properties and applications of SiC, Al_2O_3 and PSZ

Mechanical properties and testing of materials: Mechanical properties of materials - testing methods- metallography – specimen preparation – optical microscope - jominy end quench test - tensile test - stress-strain curve (Engineering and True) – compression test – shear test – torsion test – hardness tests – impact test – fatigue test- S-N curve – creep test- creep curve - fractures – types of fractures – Griffith criterion - wear test – ASTM for above testing methods – Non destructive testing – liquid penetrant test, ultrasonic test and magnetic particle inspection.

Total Number of Theory Hours	**45**

Laboratory components

S.No	List of Experiments	CO Mapping	RBT
1	Study of specimen preparation and microscopes	C304.4	[U]
2	Microstructure examination of steel specimen in the following conditions	C304.3 C304.4	[A]

	• Annealed condition • Hardened condition • Normalized condition		
3	Tensile test on metals to determine tensile strength and ductility	C304.4	[Ap]
4	Compression test on wood / bricks to determine compressive strength	C304.4	[Ap]
5	Shear test on mild steel and aluminium rods to find shear strength	C304.4	[Ap]
6	Torsion test on mild steel rod to find shear modulus	C304.4	[Ap]
7	Impact test on metal specimen to determine the impact strength and toughness • Izod test • Charpy test	C304.4	[Ap]
8	Hardness test on ferrous and non ferrous metals to determine • Brinnel hardness number • Vicker's hardness number • Rockwell hardness number	C304.4	[Ap]
9	Deflection test on steel and aluminium beam to find modulus of elasticity	C304.4	[Ap]
10	Study of flexural, fatigue and wear test	C304.4	[Ap]

Text Books:

1	W.D. Callister, 'Material Science and Engineering – An introduction' 6th edition, Wiley India, 2006.
2	Kenneth G Budinski and Michael K Budinski, "Engineering Materials properties and selection", PHI learning private limited, 2012.

Reference Books:

1	Sidney.H Avner , "Introduction to Physical Metallurgy", McGraw Hill Education, 2013.
2	G. E.Dieter, Mechanical Metallurgy, McGraw Hill, 2014.
3	V. Raghavan "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2004

Web References:

1	nptel.iitm.ac.in./courses/113105028/
2	www.sciencedaily.com/articles/m/metallurgy.html

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [Theory] [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubrics based CIA [30 marks]	
Remember	30	30	30	-	30
Understand	40	40	40	30	30
Apply	30	30	30	60	30
Analyse	-	-	-	10	10
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C304.1	3	3	3		3		3		3	2		1	1	
C304.2	3	3	2		3		3		3	2			1	
C304.3	3	3	3		3		3		3	2		3	1	
C304.4	3	3	3		3		3		3	2		1	1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18EE311	ELECTRICAL DRIVES AND MICROPROCESSOR LABORATORY	1/0/3/2.5

Nature of Course	Practical application
Pre requisites	Nil

Course Objectives:

1	To impart the basic concepts of electrical drives.
2	To impart practical knowledge on basics of microprocessor programming and interfacing
3	To impart the basic concepts of Arduino processor and its programming

Course Outcomes:
Upon completion of the course, students shall have ability to

C311.1	Identify the various electrical machines and components of electric drives	[R]
C311.2	Compare the characteristics and specifications of various electrical drives and microprocessors.	[U]
C311.3	Analyze the working of electrical machines, drives and microprocessors.	[A]
C311.4	Evaluate the performance and choose the electrical drives and microprocessors for various applications.	[E]

Course Contents:

DC and AC machines and its applications : Introduction , advantages of Electric drives, Types of motors , characteristics, armature reaction , commutation, Torque equation, Speed control concepts for DC shunt motor and Three phase induction motor, Converter, chopper fed DC motors and inverter, AC voltage controller fed induction motors, **Devices and processors:** Transistors, Introduction processors, Introduction to 8085 microprocessor, architecture, addressing modes, instruction set, timing diagram, interrupts, Mechanical applications of microprocessors/microcomputers. Arduino and programming software and Hardware Architecture, Integrated development environment of Arduino (IDE), Basic languages and its applications.

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Comparing the performance of D.C. shunt and series motor.	C311.2	[U]
2	Assessing the characteristics of methods of speed control of D.C. shunt motor.	C311.3	[A]
3	Validation of slip and torque-speed characteristics of three-phase induction motor.	C311.3	[A]
4	Study the different types of D.C. motor and induction motor starters.	C311.1	[R]
5	Performing simple arithmetic operations using 8085: addition/subtraction/multiplication/division.	C311.3	[Ap]
6	Using control instructions to perform operations such as: Increment/decrement, Ascending/Descending order, Maximum/Minimum of numbers, code conversion.	C311.3	[Ap]
7	Interfacing 8085 microprocessor with: 1. ADC, 2. DAC, 3. Stepper motor and evaluate its performance	C311.4	[E]
8	Arduino processor : 1.LED ON / OFF using NO/NC switches 2.Smoke detection using MQ2 gas sensor	C311.4	[E]
	Total Hours		**60**

Text Books:	
1	J.B. Gupta, Theory and Performance of Electrical Machines‘, S.K.Kataria and Sons, 2015.
2	Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Penram International Publishing (India) Private Limited, Sixth Edition, 2016.
3	Mebinn Marshal “ Arduino Programming 2018 : Introduction to Arduino different types of Arduino what’s on the board” kindle edition
Reference Books:	
1	Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice – Hall of India, New Delhi , 2014
2	Stephen J.Chapman, “Electric Machinery Fundamentals”, Tata McGraw Hill International Edition, New Delhi, 5th Edition, 2015
3	Pradeeka Seneviratne, “Internet of Things with Arduino Blueprints” [PACKT] open source*, Kindle edition
Web References:	
1	http://nptel.ac.in/courses/108104011/
2	http://nptel.ac.in/courses/108107029/
Online Resources:	
1	http://www.electrical4u.com/electrical-drives/
2	https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.htm

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	20	20
Understand	30	30
Apply	10	10
Analyse	20	20
Evaluate	20	20
Create	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C311.1		3	3	3	2		2	3		2		1		
C311.2		3	3	3	2		3	3		2		1		
C311.3		3	3	3	2		3	3		2		3		
C311.4		3	3	3	2		3	3		2		1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME305	MACHINE DRAWING AND ENGINEERING TOLERANCE	0/0/3/1.5
Nature of Course:	Practical Application	
Pre Requisites:	Engineering Drawing	

Course Objectives:

1	To impart the knowledge of drawing practices for common machine components.
2	To enable the students to understand blue prints and assembly drawings.
3	To impart the fundamental knowledge about geometric dimensioning and tolerance.

Course Outcomes:

Upon completion of the course, students shall have ability to

C305.1	Recall the conventional representation of mechanical components and understand the concept of joints	[U]
C305.2	Applying tolerance to mechanical components.	[Ap]
C305.3	Draw the various components/products elements using modelling software.	[Ap]
C305.4	Imagine and draw the assembled views of machine parts using modelling software.	[C]

Course Contents:

Machine Drawing Conventions - Conventional representation of machine elements- Springs, Gears**.** Representation of Fasteners - Riveted joints and Welded joints. Fits/Tolerances And Geometric Tolerances - Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances, Cumulative tolerance, Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Representation of - Straightness, flatness, circularity, cylindricity, parallelism, perpendicularity, angularity, concentricity and coaxiality, symmetry, radial run out and axial run out. ASME Y 14.5 standard for tolerance. Surface finish symbols- methods of indicating the surface roughness. Blue print reading. Assembly Concepts And Drawings - Methods and concepts of assemblies-assembly requirements. Preparation of assembly drawing and bill of materials of following assemblies from its disassembled views: Cotter joint- Sleeve & Cotter Joint, Socket and Spigot joint, Knuckle joint, Foot step bearing, Plummer block, Flange coupling, Screw Jack.

S.No	List of Exercises [Using Recent Modelling Software]	CO Mapping	RBT
1	Draw hexagonal nut and square nut, hexagonal headed bolt, square headed bolt and washer.	C305. 1 C305. 3	[Ap]
2	Draw single riveted lap joint, double riveted (chain) lap joint, double riveted (zigzag) lap joint.	C305. 1 C305. 3	[Ap]
3	Draw single riveted (single strap) butt joint, single riveted (double straps) butt joint.	C305. 1 C305. 3	[Ap]
4	Draw the assembly of Sleeve & Cotter Joint/ Socket and Spigot joint/ Knuckle joint.	C305. 2 C305. 4	[C]
5	Draw the assembly of Foot step bearing/ Plummer block.	C305. 2 C305. 4	[C]
6	Draw the assembly of Flange coupling.	C305. 2 C305. 4	[C]
7	Draw the assembly of Screw Jack.	C305. 2 C305. 4	[C]

Total Hours: 45

Text Books:

1	N. D. Bhatt, V.M. Panchal “Machine Drawing” Charotar Publishing House. 2015.
2	K. R. Gopalakrsihnan, “Machine Drawing”, Subhas Publication, 2014.

Reference Books:	
1	K.L. Narayana, P.Kannaiah, & K.Venkata Reddy, “Machine Drawing”, New Age International Publishers, 2013.
2	Ajeet Singh, “Machine Drawing” Tata Mc-Graw- Hill, 2012.
Web References:	
1	http://www.nptel.ac.in
2	http://www.sigmetrix.com
Online Resources:	
1	https://www.universalclass.com/i/crn/8683.htm
2	https://www.machinedesignonline.com

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	-	-
Understand	40	40
Apply	30	30
Analyze	-	-
Evaluate	-	-
Create	30	30

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C305.1		3	3	3	2		2	3		2		3		
C305.2		3	3	3	2		3	3		2		3		
C305.3		3	3	3	2		3	3		2		3		
C305.4		3	3	3	2		3	3		2		3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MC351	ETHICS IN ENGINEERING PRACTICE	2/0/0/0
Nature of Course	Mandatory Course	
Pre requisites	NIL	
Course Objectives:		
1	To prepare students to take up their professional responsibilities as engineers.	
2	To help them recognize and ethically approach the significant problem situations that is common in engineering.	
3	To evaluate the existing ethical standards for engineering practice	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C351.1	Practice as an engineer with professional responsibility.	[Ap]
C351.2	Approach the significant problems common in engineering with ethical values	[Ap]
C351.3	Promote ethical standards for engineering practice	[Ap]

Course Contents:

Engineering Ethics

Introduction to Ethical Reasoning and Engineer Ethics- Professional Practice in Engineering- Ethics as design- Doing justice to Moral problems

Professionalism of Engineers

Central Professional Responsibilities of Engineers- Computer, software and Digital Information

Rights and Responsibility

Rights and Responsibilities Regarding Intellectual property- Workplace Rights and Responsibilities- Responsibility for the Environment.

Total Hours	**15**

Text Books:	
1.	R. Nandagopal and AjithSankar R. N., Indian Ethos and Values in Management, Tata McGraw-Hill Publications, 2010
2	Barry L. Reece and Rhonda Brandt, Effective Human Relations 9th Edition, Cengage Publications, 2010
Reference Books:	
1	Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)
2	A.N Tripathi, Human Values, New Age International Publication 2010.
Web References:	
1	http://nptel.ac.in/courses/109104068/30

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C351.1	Remember	NPTEL Swayam / MOOC / Assignments	**50**
C351.2	Understand		
C351.3	Apply		

Summative assessment based on Continuous and End Semester Examination	
Bloom's Level	**Term End Model Examination [50 marks]**
Remember	30
Understand	50
Apply	20
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C351.1			3			3		3	3					
C351.2			3			3		3	3					
C351.3		3	3	2		3		3	3	3				

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MA403	STATISTICS AND NUMERICAL METHODS	3/1/0/4
Nature of Course	Problem analytical	
Pre requisites	Higher secondary mathematics	
Course Objectives:		
1	To study the basic probability concepts.	
2	To acquire skills in handling situations involving single random variable	
3	To study the concept of finding the roots of linear equations and nonlinear equations.	
4	To learn and construct approximate polynomial for the given numerical data and to find the intermediate missing values.	
5	To learn the concept of testing of hypothesis using statistical analysis	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C403.1	Recall basic probability and integration concepts.	[R]
C403.2	Understand to handle situations involving random variables and Standard distributions.	[U]
C403.3	Apply numerical methods to solve algebraic, transcendental and simultaneous equations.	[Ap]
C403.4	Apply numerical methods to fit the polynomial.	[Ap]
C403.5	Develop inference for engineering problems using testing of hypothesis	[Ap]

Course Contents:

Probability and Random Variables- Probability concepts-Addition and Multiplication law of probability – Conditional probability - Total probability theorem, Baye's theorem(statement) – Problems - One dimensional random variable - Probability mass function - Probability density function-Discrete and continuous random variables- MGF, Mean and variance **Standard distributions -** Discrete distributions : Binomial – Poisson – Geometric - Continuous distributions : Uniform – Exponential - Normal – Simple Problems.

Numerical methods: Newton-Raphson method – Gauss Elimination method - Gauss Seidel method – Newton's Forward and Backward difference formula - Lagrange's interpolation formula- Trapezoidal rule, Simpson's 1/3 rule and 3/8 rule - Double integrals using Trapezoidal and Simpson's rules.

Testing of Hypothesis- Large sample- Normal distribution- single mean- difference of means- Small sample - t distribution- single mean- difference of means- F distribution- variance - Chi-square distribution- test for goodness of fit and independence of attributes.

Total Hours	**60**

Text Books:

1	Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2016
2	Palaniammal, S., "Probability and Random Processes", Prentice hall of India, New Delhi, 2014, Reprint 2015.
3	Gerald C.F. and Wheatley, P.O. "Applied Numerical Analysis", 6th edition Pearson Education Asia, New Delhi.
4	Gupta, S.C., & Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & sons, 2000, Reprint 2014.

Reference Books:

1	Ross S, "A First Course in Probability", Ninth edition, Pearson Education, Delhi, 2014.
2	Henry Stark and John W. Woods "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Fourth Edition, Delhi,

	2011.
3	N.P.Bali, “A Text book of Engineering Mathematics” 13th edition, Laxmi publications ltd, 2017.
4	P. Kandasamy, K. Thilagavathy and K. Gunavathy, “Numerical methods”, S.Chand Co. Ltd., New Delhi, 2003.
Web References:	
1	http://nptel.ac.in/courses/111104079/
2	http://www.nptelvideos.in/2012/12/probability-random-variables.html
3	http://freevideolectures.com/Course/3028/Econometric-Modelling/22
4	http://freevideolectures.com/Course/2311/Digital-Communication/4
5	http://nptel.ac.in/syllabus/111105041/
Online Resources:	
1	https://www.coursera.org/learn/probability-intro
2	https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3	https://www.coursera.org/learn/wharton-introduction-spreadsheets-models/lecture/Y3bCF/3-1-random-variables-and-probability-distributions
4	http://nptel.ac.in/upcoming_courses.php

Tentative Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C403.1	Remember	Classroom or Online Quiz	2
C403.2	Understand	Tutorial	4
C403.3	Apply	Group Assignment	6
C403.4 & C403.5	Apply	Group activities	8

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 Mark]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C403.1	1	1			3							2		
C403.2	2	2			2							1		
C403.3	3	3			2							1		
C403.4	3	3			1							1		
C403.5	3	3			3							1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME401	AUTOMOBILE ENGINEERING (INDUSTRY BASED COURSE)	2/0/2/3
Nature of Course	Theory Technology	
Pre Requisites	Thermodynamics	
Course Objectives:		
1	To enable the students to understand the working of various automobile systems.	
2	To prepare the students to update their knowledge in upcoming technology related to automobiles.	
3	To enable the students to modify various automobile systems.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C401.1	Describe the fundamental concepts of automobile engineering	[R]
C401.2	Discuss the various mechanisms involved in automobile systems.	[U]
C401.3	Explore the advanced mechanisms in current vehicles.	[Ap]
C401.4	Survey the various systems of the vehicle.	[A]
C401.5	Design the components of automotive systems.	[C]

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

AUTOMOBILE AND ENGINE ARCHITECTURE: Automobile – types, components, subsystems and their positions - Power required for automobile - resistance and force - Chassis, frame and body–Engine- classification, components - An overview of Cooling and Lubrication systems– Petrol and Diesel fuel feed system- drawbacks- Petrol engine fuel injection (MPFI) and diesel engine fuel injection (CRDI) –VVTi engine, GDI technology, BS -VI Engine technology, Turbo engine -supercharging and turbo charging. **AUTOTRONICS:** An overview of basic electrical components and circuits in an automobile - overview of vehicle electronic systems.

EMISSION CONTROL AND ALTERNALE ENERGY SOURCE: An overview of SI and CI Engine emission and its control, Emission norms BS -VI, Non-exhaust and exhaust emission types (description only) -An overview of environment friendly energy sources: bio fuels, electricity vehicle, hybrid vehicle, hydrogen fuel cell. **TRANSMISSION LINES AND AXLES: Power train:** Clutch, Single plate, diaphragm, multi plate clutch- Gear box, sliding mesh, synchromesh, automatic gearbox, torque converter, overdrive gear changing mechanism types **Drive Line:** Universal joints and Propeller shaft types, **Rear axle:** types of rear axle, **Final Drive:** Differential unit, Differential Lock, Limited Slip Differential.

VEHICLE CONTROL SYSTEMS: Front axle: Types of front axle **Steering System:** Ackermann principle, manual steering, wheel geometry, rack and pinion, recirculating ball screw steering gear box, Power steering types- **Suspension system**: Types of suspension systems – coil spring, leaf spring, shock absorber, air suspension, hydro assisted suspension. **Brake system**: braking system types – hydraulic drum brake, disc brake, air brake, power assisted brake, ABS - **Wheels and Tyres:** Types of wheels, tyres and tubes.

Total Hours	**45**

Text Books:	
1	Anil chhikara, "Automobile engineering", Vol. 1&2 Tech India Publications, New Delhi,3th edition, 2015.
2	Kirpal Singh, "Automobile Engineering", Vol. 1&2, Standard Publishers, Delhi, 13th edition, 2012.
Reference Books:	
1	Crouse and Anglin, "Automotive Mechanics", McGraw Hill Education, 10th edition, 2017.
2	Julian Happian-Smith "Introduction to Modern Vehicle Design", Publisher: Society of Automotive Engineers Inc. 1st edition, 2012.

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks: 20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C401.1	Remember Understand	Hands on Training/ Industrial Case Study with Poster Presentation	10
C401.2			
C401.3	Apply Analyze Create	Project work with Poster Presentation / Vehicle fabrication	10
C401.4			
C401.5			

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	50	30	30	35
Understand	25	40	30	35
Apply	25	20	30	20
Analyse	-	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C401.1	3	3	3		3		3		3	2		2	1	1
C401.2	3	3	2		3		3		3	2				
C401.3	3	3	3		3		3		3	2		2	2	1
C401.4	3	3	3		3		3		3	2		3	2	1
C401.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME402	KINEMATICS OF MACHINERY	3/1/0/4
Nature of Course:	Theory Analytical	
Pre Requisites:	Engineering Mechanics	

Course Objectives:

1	To identify functional characteristics of various machine elements.
2	To analyse position , velocity and acceleration of simple mechanisms
3	To demonstrate design and analyse of cams and gears.
4	To understand the effects of friction in motion transmission and in machine components.

Course Outcomes:
Upon completion of the course, students shall have ability to

C402.1	Demonstrate and apply the principles of kinematics	[U]
C402.2	Calculate the Position, velocity and acceleration of simple planar mechanisms.	[A]
C402.3	Develop the profile of the cam.	[A]
C402.4	Analyse and determine the parameters involved in the gears	[A]
C402.5	Discover the effects of friction in mechanical element	[Ap]

Course Contents:

Introduction of Mechanisms and Machines: Concepts of Kinematics , Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, Kutzbach and Grubler's criterion, Grashof's criterion. Coupler curves, Toggle and Limit Position, Transmission angle, Mechanical Advantage.

Velocity and Acceleration Analysis: Velocity and Acceleration Diagrams of simple mechanisms (single slider and four bar), Rubbing Velocity, Corioli's component of acceleration. Chebyshcv spacing for precision positions, Roberts's chebvshec theorem, Frudenstine's Equation **Cams:** Definitions of cam and followers uses, Types of followers and cams, Terminology, Types of follower motion – Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases. Analysis of motion of followers: Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

Gears: Gear terminology, law of gearing, involute and cycloidal profiles, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears, methods of avoiding interference, back lash, condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact. **Gear Trains**: Simple gear trains, compound gear trains. Epicyclic gear trains: Tabular methods of finding velocity ratio of epicyclic gear trains. **Friction Drives** : Introduction, belt and ropes drives, selection of belt drive, types of belt drives, V-belts, materials used for belt and rope drives, wire rope, Slip and Creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt. Friction clutches-single, multi-plate, cone clutch. Friction in screws with square thread and V threads.

Total Hours:	**60**

Text Books:

1	Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
2	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.

Reference Books:	
1	F.B. Sayyad, “Kinematics of Machinery”, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011
2	Ambekar A.G., “Mechanisms and Machine Theory”, Prentice Hall of India, New Delhi, 2007
3	Dr.R.K.Bansal and Dr.J. S. Brar, “A Text book of Theory of Machines”, Laxmi publications, 2011.
Web References:	
1	nptel.ac.in/courses/Webcourse- contents/.../Kinematics%20of%20Machine/index.html
Online Resources:	
1	http://kmoddl.library.cornell.edu/

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C402.1	Understand	Group Assignment	5
C402. 2	Analyze	Tutorials /Mini project / Case study	10
C402. 3			
C402. 4			
C402. 5	Apply	Individual Assignment	5

Summative assessment based Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	10	10	10
Understand	30	20	20	20
Apply	-	20	40	40
Analyse	50	50	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C402.1	3	3	3						1	1		3		
C402.2	3	3	3						3	1		3		
C402.3	3	3	3						3	1		3		
C402.4	3	3	3						3	1		2		
C402.5	3	3	3							1		2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME403	FLUID MECHANICS AND MACHINERY (WITH LAB)	3/0/2/4

Nature of Course	Theory and Practical
Pre Requisites	Basic Mathematics and Engineering Physics

Course Objectives:

1	To understand the properties of the fluid.
2	To analyze and appreciate the complexities involved in solving the fluid flow problems.
3	To study the mathematical techniques and apply them to solve the practical flow problems.
4	Learn to apply conservation of laws to flow through pipes.

Course Outcomes:
Upon completion of the course, students shall have ability to

C403.1	Understand the basic properties of fluid.	[R]
C403.2	Analyze the fluid flow and its behaviour.	[A]
C403.3	Understand the behaviour of boundary layer flows.	[R]
C403.4	Analyze the dependent and independent dimensionless parameters.	[A]
C403.5	Evaluate the performance of pumps and turbines.	[E]

Course Contents:

Basic Concepts and Fluid Properties - density, specific weight, specific volume, specific gravity, viscosity, compressibility, capillary, surface tension and buoyancy - forces on submerged bodies. **Measurement of Pressure**: Pascal's law and Hydrostatic equation - concept of fluid static pressure, Measurement of Pressure using Manometers.

Fluid Dynamics - Euler's equation - Bernoulli's equation and its applications. Laminar flow – Hagan Poiseuille equation - Turbulent flow – Darcy Weisbach formula - Major and minor losses of flow in circular pipes. Pipes in series and in parallel.

Dimensional Analysis - Dimension and Units - Buckingham π theorem – similitude – Dimensionless numbers -Model analysis. **Pumps** (Descriptive) - centrifugal pumps, Reciprocating pump - working principles, Cavitation in pumps .**Turbines** (Descriptive) - Pelton wheel, Francis turbine and Kaplan turbines, working principles - Specific speed.

Total Number of Theory Hours	**45**

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Determination of the Coefficient of discharge of given Orifice meter.	C403.2	[A]
2	Determination of the Coefficient of discharge of given Venturi meter.	C403.2	[A]
3	Determination of the rate of flow using Rotameter.	C403.2	[A]
4	Determination of friction factor for a given set of pipes.	C403.2	[A]
5	Performance characteristics of submergible Pump.	C403.5	[E]
6	Performance characteristics of centrifugal pump.	C403.5	[E]
7	Performance characteristics of reciprocating pump.	C403.5	[E]
8	Performance characteristics of Gear pump.	C403.5	[E]
9	Performance characteristics of Pelton wheel.	C403.5	[E]
10	Performance characteristics of Francis turbine.	C403.5	[E]

11	Performance characteristics of Kaplan turbine.	C403.5	[E]
12	Study of Hydro Electric Power Plant	C403.5	[U]
13	Meta Centre Experiment	C403.5	[E]

Text Books:	
1	Streeter, V.L., and Wylie, E.B., “Fluid Mechanics”, McGraw-Hill Education, 2010.
2	Rajput, R.K., “Fluid Mechanics and Hydraulic Machines”, S.Chand Publishers, 2008.
3	Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi 2009.
Reference Books:	
1	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2010
2	Bansal, R.K. “Fluid Mechanics and hydraulic Machines”, Laxmi Publications (P) Ltd., New Delhi,2015
3	Introduction to Fluid Mechanics, Robert W. Fax, Philip J. Pritchard, Alan T. McDonald. Wiley India Edition. (Wiley Student Edition Seventh 2011).
Web References:	
1	http://www.nptel.ac.in
2	http://www.creativeworld9.com
Online Resources:	
1	https://www.reddit.com/r/fluid_mechanics_online_andor_textbook_resources
2	www.efluids.com

Tentative Assessment Methods & Levels (based on Blooms’ Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	40	30	30	10	30
Understand	40	30	40	10	30
Apply	-	-	-	-	-
Analyse	20	40	30	40	40
Evaluate	-	-	-	40	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C403.1	3	2	2									3		
C403.2	2	2	2								2	3		
C403.3	3	3	2								2	3		
C403.4	3	3	2	2	2				1		2	2		
C403.5	3	2	3	2								2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME404	THERMAL ENGINEERING (WITH LAB)	3/0/2/4
Nature of Course	Theory applications	
Pre Requisites	Engineering thermodynamics and Mathematics	
Course Objectives:		
1	To study the fuel properties, performance of I.C Engines.	
2	To understand the performance of air compressors.	
3	To impart knowledge of the psychrometric processes and air conditioning systems.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C404.1	Identify and describe air standard cycles for air standard efficiencies	[U]
C404.2	Illustrate the nomenclature, fuels used and gain ability to conduct performance test in engines.	[E]
C404.3	Compare and calculate the performance of reciprocating and rotary equipment.	[A]
C404.4	Classify, solve and calculate the psychrometry processes and air conditioning systems performance.	[A]

Course Contents:

IC Engine analysis: Air standard analysis - Carnot cycle - Otto cycle - Diesel cycle, Classification- Principle and working of four stroke and two stroke petrol and diesel engines, Combustion process- Knocking, Detonation, Cetane and Octane numbers, Combustion in SI and CI engines.

Air Compressors: Single stage reciprocating compressor- Working principle, Multistage reciprocating compressors: Working principle. Rotary compressor (Descriptive): Vane compressor, Screw compressor and lobe compressor.

Psychrometry and Air Conditioning: Psychrometry and Psychrometric charts, Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, Evaporative cooling, Introduction to HVAC (Descriptive) - Air handling and distribution system, Self cleaning / Electro static precipitation in Air conditioning.

Total Number of Theory Hours	**45**

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Experimental study on valve timing diagram in 4-stroke engine cut model and port timing diagram in 2-stroke engine cut model.	C404.2	[A]
2	Performance and Heat balance test on a twin cylinder diesel engine with electrical dynamometer (Alternator).	C404.2	[E]
3	Performance characteristics of a centrifugal blower test rig.	C404.3	[A]
4	Air compressor test rig (Two stage).	C404.3	[A]
5	Performance and combustion test on computerized Kirloskar TV1 engine with eddy current dynamometer. (In diesel mode).	C404.2	[E]
6	Experiments on air-conditioning system.	C404.4	[A]
7	Determination of flash and fire point by open cup apparatus.	C404.2	[A]

8	Determination of viscosity – Redwood viscometer.	C404.2	[A]

Text Books:	
1	Mahesh M. Rathore, “Thermal Engineering”, Mc Graw Hill Education private limited, Reprint 2016.
2	Kothandaraman.C.P, Domkundwar.S, Anand Domkundwar, “A Course in Thermal Engineering”, Dhanpat Rai & Co. (P) Ltd., 2017.
Reference Books:	
1	Rudramoorthy R, “Thermal Engineering”, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
2	Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
3	Arora C.P. “Refrigeration and Air Conditioning” Tata McGraw Hill, 2017.
Web References:	
1	http://nptel.ac.in/courses/112104033/
2	http://nptel.ac.in/courses/112105128/
Online Resources:	
1	https://ocw.mit.edu/courses/mechanical-engineering/

Tentative Assessment Methods & Levels (based on Blooms’ Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	20	20	20	10	20
Understand	30	30	30	10	30
Apply	30	30	30	20	30
Analyse	20	20	20	30	20
Evaluate	-	-	-	30	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C404.1	3	2	2	1			1					1		
C404.2	3	2	2					1			2	1		
C404.3	3	2	2		1	1					2	2		
C404.4	3	2	2								2	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME405	MANUFACTURING TECHNOLOGY – II (WITH LAB)	3/0/2/4
Nature of Course	**Theory concepts and laboratory**	
Pre Requisites	**Manufacturing Technology I**	

Course Objectives:

1	To understand the concepts of metal cutting and measurements.
2	To understand the working of standard machine tools, special purpose machines and allied machining processes.
3	To study the advancements in manufacturing operations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C405.1	Understand the basics of metal cutting processes and various machining operations.	[U]
C405.2	Discuss the working principle of special purpose machines and various mechanisms involved.	[U]
C405.3	Categorize the various finishing operations and advanced manufacturing methods.	[Ap]
C405.4	Understand the working of CNC machine tools and different measuring techniques.	[U]
C405.5	Make components using various manufacturing processes and analyze their machining time.	[A]

Course Contents:

Theory of Metal Cutting: Introduction, cutting tool: Types, materials and life. Theory of metal cutting: Merchant's circle, cutting force measurements - Chip formation. **Centre Lathe:** Constructional features, various operations, work holding devices and machining time estimation. Capstan and turret lathes – Automats: Single and Multi spindle.

Special Purpose Machines and Abrasive processes: Shaper, Planer, Slotter machines. Milling machines: Types, cutters and various operations. Drilling machines: Types, Operations. Broaching - Gear cutting: forming, generation, shaping, Grinding Process: Introduction, types of grinding processes - Finishing processes: Honing, lapping, super finishing, polishing and buffing.

Advanced Manufacturing Methods and Measurement techniques: Mechanical energy based processes - Electrical energy based process - Chemical energy based process - LASER material processing. CNC machines: Introduction, machine structure and drives, feedback devices and part programming fundamentals. Dimensions and form measurements: Linear and angular measurements, interferometry, straightness and flatness measurement- Process planning and material handling and devices, laser inspection and workpiece quality.

Total Number of Theory Hours	**45**

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Taper turning and external thread cutting using lathe	C405.5	[Ap]
2	Measuring various angles involved in a single point cutting tool	C405.5	[Ap]
3	Measurement of cutting forces in Turning / Milling process	C405.5	[Ap]
4	Contour milling and keyway slotting	C405.5	[Ap]
5	Fasten the two different plates using drilling, reaming and tapping processes	C405.5	[Ap]
6	External dovetail and internal dovetail	C405.5	[Ap]
7	Make a spur gear / helical gear using hobbing machine.	C405.5	[Ap]

8	Improve the surface finish of the given component using grinding process	C405.5	[Ap]
9	Study CNC turning centre.	C405.4	[U]
10	Estimate the cycle timing of the machining operation	C405.5	[A]
11	Every student must undergo minimum of 3 industrial visits during the activity day.	C405.1	[U]

Text Books:

1	Serope Kalpakjian, “Manufacturing Engineering and Technology”, Pearson India, 4th edition. 2014
2	Rao, P.N. “Manufacturing Technology - Metal Cutting and Machine Tools,” McGraw – Hill Education, New Delhi, 2013.

Reference Books:

1	Hajra Choudhury, “Elements of Workshop Technology”, Vol. I & II, Media Promotors Pvt Ltd., 2011.
2	HMT - “Production Technology”, McGraw-Hill Education, 2014.

Web References:

1	https://nptel.ac.in/courses/112105127/
2	www.sme.org

Tentative Assessment Methods & Levels (based on Blooms’ Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	20	10	10	20	10
Understand	40	20	20	20	10
Apply	40	40	30	40	40
Analyse	-	30	40	20	40
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C405.1	3	3	3		3		3		3	2			3	
C405.2	3	3	2		3		3		3	2			1	
C405.3	3	3	3		3		3		3	2			3	
C405.4	3	3	3		3		3		3	2			3	
C405.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18MC352	CONSTITUTION OF INDIA AND ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2/0/0/0
Nature of Course	Mandatory Course	
Pre requisites	NIL	

Course Objectives:

1	To explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution.
2	To survey the basic structure and operative Indian Constitution dimensions of.
3	To study the basic science followed in Indian tradition.

Course Outcomes:
Upon completion of the course, students shall have ability to

C352.1	Visualize the nature of Indian Political and legal system.	[U]
C352.2	Interpret the structure of Indian Constitution.	[Ap]
C352.3	Understand the basic science of Indian Traditional Knowledge	[Ap]

Course Contents:

Indian Constitution

Historical Background – Principles of the Constitution – Fundamental Rights – Directive Principles – Centre-State Relations – Division of Power.

Constitution and Structure

Legislature, Executive, Judiciary; Institutions: President, Governors, Statutory bodies – Amendments to the Constitution.

Indian knowledge and Tradition System

Basic structure of Indian Knowledge System -Modern Science and Indian Knowledge System – Yoga and Holistic Health care – Philosophical Tradition-Indian Linguistic Tradition – Indian Artistic Tradition.

Total Hours	**15**

Reference Books:

1	D D Basu, "Introduction to the Constitution of India", 23rd Edn.,Lexisnexis Butterworths, 2018.
2	V. Sivaramakrishnan (Ed.), "Cultural Heritage of India-course material", Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014.

Tentative Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:50)

Course Outcome	Bloom's Level	Assessment Component	Marks
C352.1	Remember	NPTEL Swayam / MOOC / Assignments	**50**
C352.2	Understand		
C352.3	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Term End Model Examination [50 marks]
Remember	30
Understand	50
Apply	20
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)														
COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C352.1			3			2	3		2		3			
C352.2			3			2	3		2		3			
C352.3			3			2	3		2		3			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME501	DESIGN OF MACHINE ELEMENTS (PROJECT BASED COURSE)	3/0/1/3.5
Nature of Course	Concept and Analytical	
Pre Requisites	Engineering Mechanics, Strength of Materials, Kinematics of Machinery	
Course Objectives:		
1	To familiarize the various steps involved in the design process.	
2	To understand the principles involved in evaluating the shape and dimensions of a component in order to satisfy functional and strength requirements.	
3	To encourage the usage of standard practices and standard data.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C501.1	Understand the concept of various processes involved in machine design.	[U]
C501.2	Elucidate the variety of stresses induced in machine components to resolve the design of machine components.	[Ap]
C501.3	Familiarize with standard design data and select the appropriate mechanical components.	[A]
C501.4	Summarize the results of a design assignment by means of drawing and design report.	[E]
C501.5	Design and make a model of the learnt concepts.	[C]

Course Contents:

Steady and Variable Stresses in Machine Elements: Introduction to the Design Process – Direct – Bending and Torsional Stress Equations – Eccentric Loading – Impact and Shock Loading – Calculation of Principle Stresses for Various Load Combinations – Theories of Failure – Design of Curved Beams, Crane Hook and C Frame – Stress Concentration – Design for Variable Loading, Soderberg, Goodman and Gerber Relations.

Design of Shafts, Couplings and Fasteners: Design of Solid and Hollow Shafts – Design of Knuckle Joint – Design of Keys and Couplings – Threaded Fasteners – Design of Welded Joints – Design of riveted joints (Various types of failures alone) – Theory of Bonded Joints.

Design of Springs and Bearings and Connecting Rod: Design of Helical and Leaf springs – Selection of Bearings, Sliding Contact, Design of Journal Bearing and Rolling Contact bearing, Design of Connecting Rod (I-section alone).

Total Hours: 60

Text Books:	
1	Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, 10th Edition, McGraw-Hill , 2014.
2	Bhandari V.B, “Design of Machine Elements”, McGraw-Hill Book Co, 2017.
Reference Books:	
1	R.S.Khurmi and J.K.Gupta, “A Text Book of Machine Design", S.Chand Publications, 2014.
2	Orthwein W, “Machine Component Design”, 2nd Jaico Publishing Co, 2016.
3	Spotts M.F., Shoup T.E “Design of Machine Elements” 8th edition, Pearson Education, 2006.
Web References:	
1	https://nptel.ac.in/courses/112105124/5
2	https://www.coursera.org/learn/machine-design1
3	https://ocw.mit.edu/courses/mechanical-engineering/2-75-precision-machine-design-fall-2001/

Online Resources:	
1	https://www.machinedesignonline.com/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C501.1	Understand	Tutorials/Assignments	5
C501.2	Apply	Poster presentation and Case study	5
C501.3	Analyze		
C501.4	Evaluate	Mini Project	10
C501.5	Create		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	10	10	10	10
Understand	30	20	20	20
Apply	20	30	30	30
Analyze	20	20	20	20
Evaluate	20	20	20	20
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C501.1	3	3	3		2			2	1		2	3	1	
C501.2	3	3	3		3			1	1		3	3	1	
C501.3	3	3	3		3			1	1		2	3	1	
C501.4	3	3	3		3			1	1		3	3	1	
C501.5	3	3	3		3			1	1		2	3	1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME502	INDUSTRY 4.0	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Manufacturing Technology-I (with lab), Manufacturing Technology-II (with lab) and Electrical Drives and Microprocessor Laboratory	

Course Objectives:

1	To introduce the concepts of Industry 4.0
2	To understand the various systems and technologies used for implementing industry 4.0.
3	To learn about the fundamentals of IoT, cloud computing and big data analytics.

Course Outcomes:
Upon completion of the course, students shall have ability to

C502.1	Understand the drivers and enablers of Industry 4.0.	[U]
C502.2	Understand the smartness in smart factories, smart cities, smart products and smart services.	[U]
C502.3	Apply the various systems and technologies used in Industry 4.0.	[Ap]
C502.4	Design the components for Industry 4.0 using learned concepts such as IoT, cloud computing and data analytics.	[C]

Course Contents:

Introduction to Industry 4.0: The Industrial Revolutions, Characteristics of Industry4.0, Digitalisation and the Networked Economy, Compelling Forces and Challenges for Industry 4.0; Comparison of Industry 4.0 Factory and Today's Factory, Fundamentals of Machine Learning, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

Technologies enabling Industry 4.0: Industrial Internet of Things (IIoT) & Internet of Services, Predictive Analytics, Cyber physical Systems; Robotic Automation and Collaborative Robots; Support System for Industry 4.0, Mobile Computing, Cyber Security, Cloud Computing Basics, Cloud Computing and Industry 4.0.

Application of Industry 4.0: Smart Manufacturing, Virtual Power Plants, e-commerce for manufacturing, Industrial 3D printing, e-mobility, The Stages of High fossil fuel consumption for Industry 4.0, Impacts of Lean Production System, Connected factory.

Total Hours: 45

Text Books:

1	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 2016.
2	Alp Ustundag, Emre Cevikcan, “Industry 4.0 Managing The Digital Transformation”, Springer International Publishing, 2018.

Reference Books:

1	Lane Thames, Dirk Schaefer, “Cyber Security for Industry 4.0 Analysis for Design and Manufacturing”, Springer International Publishing, 2017.
2	Best Masters, Christoph Jan Bartodziej, “The Concept Industry 4.0 An Empirical Analysis of technologies and Applications in Production Logistics”, Springer Gabler, Springer Fachmedien Wiesbaden GmbH 2017.
3	Oliver Grunow, “The Current state of Application Technologies Smart Factory and Industry 4.0”, Studylab, 2016.

Web References:

1	https://www.bcg.com/en-in/capabilities/operations/embracing-industry-4.0-rediscovering-growth.aspx
2	https://www.forbes.com/sites/bernardmarr/2018/09/02/what-is-industry-4-0-heres-a-super-easy-explanation-for-anyone/#53b174589788.

Online Resources:	
1	https://prod-edxapp.edx-cdn.org/assets/courseware

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C502.1	Understand	Quiz	5
C502.2	Apply	Case Study/ Group Assignment	5
C502.3			
C502.4	Create	Mini Project	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	30	20	20	20
Understand	60	40	40	40
Apply	10	40	30	30
Analyze	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C502.1		3		3	3	3	2		2	3		1		2
C502.2	3	3			2	3		2	2	3	3	2		3
C502.3	3	3	3		3	3		2	3	3	2	1		3
C502.4	3				3	3		2	1	3		1		3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME503	DYNAMICS OF MACHINERY (WITH LAB)	3/0/2/4
Nature of Course	Practical application	
Pre requisites	Engineering mechanics, Kinematics of Machines	

Course Objectives:

1	To enable the students to understand the principles of static force analysis and dynamic force analysis of mechanisms.
2	To provide an insight to the undesirable effects of unbalance in rotors and engines.
3	To introduce the concept of vibratory systems and damping methods.
4	To enable the students understand the principles of governors and gyroscope applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C503.1	Determine the forces acting on machines and mechanisms such as flywheels, and engines.	[Ap]
C503.2	Perform static and dynamic balancing calculations for rotating and reciprocating machinery.	[A]
C503.3	Evaluate the various types of vibrations and to impart knowledge in calculating natural frequency and forces caused due to unbalance in masses.	[E]
C503.4	Analyze the various types of governors and their efficiency and determine the gyroscopic couple on motorized gyroscope both experimentally and analytically.	[A]

Course Contents:

FORCE ANALYSIS AND FLYWHEELS: Static force analysis of mechanisms – D‟ Alembert's principle - inertia force and inertia torque – principle of superposition. Dynamic force analysis - dynamic analysis in reciprocating engines - crank shaft torque – engine shaking forces - Turning moment diagrams in Flywheels of engines. **BALANCING:** Static and dynamic balancing - balancing of rotating masses - balancing of single cylinder engine – primary and secondary unbalanced forces - partial balancing of uncoupled locomotive engines.

VIBRATION: Basic features of vibratory systems - single degree of freedom, free vibration - equations of motion - natural frequency. Transverse vibration – whirling of shafts and critical speed. Torsional vibration - natural frequency of two rotor and three rotor systems.

MECHANISMS FOR CONTROL: Governors - types - centrifugal governors – Watt, porter, Proell and Hartnell governers – characteristics - effect of friction. Gyroscopes – gyroscopic couple - gyroscopic stabilization - gyroscopic effects in airplanes, ships and automobiles.

Total Number of Theory Hours	**45**

Laboratory Components

S. No	List of Experiments	CO Mapping	RBT
1	Balancing of rotating masses and reciprocating masses.	C503.2	[A]
2	Determination of transmissibility ratio using vibrating table.	C503.3	[E]
3	Determination of range, sensitivity, effort of Watt governor.	C503.4	[A]
4	Determination of range, sensitivity, effort of Porter governor.	C503.4	[A]
5	Determination of range, sensitivity, effort of Proell governor.	C503.4	[A]
6	Determination of range, sensitivity, effort of Hartnell governor.	C503.4	[A]
7	Determination of critical speed of shaft.	C503.3	[E]

8	Determination of Natural frequency of Spring mass system.	C503.3	[E]
9	Determination the moment of inertia of connecting rod and flywheel using compound pendulum method.	C503.1	[Ap]
10	Determination of gyroscopic couple using motorized gyroscope.	C503.4	[A]
11	Determination the moment of inertia of turn table apparatus.	C503.1	[Ap]
12	Determination the moment of inertia using bifilar suspension.	C503.1	[Ap]
13	Determination of transverse frequency of beam.	C503.3	[E]

Text Books:	
1	Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2014.
2	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2013.
Reference Books:	
1	Shigley J.E and Uicker J.J, "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 2014.
2	Sadhu Singh, “Theory of Machines”, Pearson Education, 2012.
Web References:	
1	https://www.edx.org/course/dynamics-mitx-2-03x
Online Resources:	
1	http://nptel.ac.in/courses/108104011/
2	http://nptel.ac.in/courses/108107029/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	20	20
Understand	30	30
Apply	10	10
Analyze	20	20
Evaluate	20	20
Create	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C503.1	3	3			3				2		3	3		
C503.2	3	3			3			2	2		2	3		
C503.3	3	3	3		3			2	3		2	3		
C503.4	3				3			2	1			3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME504	HEAT AND MASS TRANSFER (WITH LAB)	3/0/2/4
Nature of Course	Problem analytical & experimental	
Pre Requisites	Thermal Engineering, Engineering Thermodynamics	

Course Objectives:

1	To impart knowledge on the theoretical and analytical concepts to analyze the modes of heat transfer.
2	To enable the students to apply various laws of heat transfer in engineering applications.
3	To enable the students to analyze heat exchangers using LMTD and NTU methods.
4	To interpret the concepts underlying the types of mass transfer.

Course Outcomes:
Upon completion of the course, students shall have the ability to

C504.1	Summarize the basics of different modes and laws of heat transfer.	[U]
C504.2	Compute heat transfer and temperature distribution in steady-state, unsteady-state heat conduction and extended surfaces.	[Ap]
C504.3	Interpret and analyse forced and free convection heat transfer.	[A]
C504.4	Analyse the heat exchangers using LMTD and NTU methods.	[A]
C504.5	Analyse the different modes of mass transfer.	[A]
C504.6	Evaluate the radiative properties of a surface.	[E]

Course Contents:

Conduction Heat Transfer: Fourier Law of Conduction, General Differential equation of Heat Conduction- Cartesian Coordinates, 1-D Steady State Heat Conduction (Plane Wall, Cylinders) Composite Systems, Extended Surfaces (Circular, Rectangular).

Convection Heat Transfer and Heat Exchangers: Heat Transfer Coefficients – Boundary Layer Concept, External Flow – Flow over Plates, Cylinders, Internal Flow, Phase Change Heat Transfer (descriptive) - Nusselt's theory of condensation and Regimes of boiling, Heat Exchangers**-** Analysis – LMTD & NTU methods (Numericals) Heat pipes (descriptive) – construction and working.

Radiation Heat Transfer and Mass transfer: Laws of Radiation, Black and Grey body radiation, shape factor algebra- perpendicular planes, Radiation Shields, Diffusion Mass Transfer – Fick's Law of Diffusion, equimolar counter diffusion, Convective Mass Transfer

Total Number of Theory Hours	**45**

Laboratory Components

S. No	List of Experiments	CO Mapping	RBT
1	Determine the thermal conductivity of insulation by using lagged pipe apparatus.	C504.2	[Ap]
2	Heat Transfer from pin-fin (Forced convection mode).	C504.2	[Ap]
3	Natural convection heat transfer from a vertical cylinder.	C504.3	[Ap]
4	Forced convection inside tube.	C504.3	[A]
5	Effectiveness of parallel and counter flow heat Exchanger.	C504.6	[E]
6	Determination of Stefan- Boltzmann constant.	C504.6	[E]
7	Determination of Emissivity of a grey surface.	C504.6	[E]

Text Books:	
1	Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International, 2010.
2	Kothandaraman C.P “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2012.
Reference Books:	
1	Yunus.A.Cengel, Afstin J.Ghajar, “Heat and Mass Transfer – Fundamentals and Applications”, McGraw Hill, Fifth Edition, 2016.
2	Incropera, F. P. and De Witt, D. P., “Fundamentals of Heat and Mass Transfer”, 5th Edition, John Wiley and Sons, New York, 2011.
3	Holman J.P “Heat and Mass Transfer”, McGraw-Hill, 2010.
4	Nag P.K, “Heat and Mass Transfer”, McGraw-Hill, 2011.
Web References:	
1	www.academia.edu/.../Frank_P_Incropera_Fundamentals_of_heat_and_mass_transfer
2	http://165.165.123.124:444/Mechanical%20Engineering%20%2825%29/Heat%20and%20Mass%20Transfer
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc16_me06

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 marks]	
Remember	20	20	10	10	10
Understand	50	50	50	20	40
Apply	20	20	30	30	30
Analyze	10	10	10	20	20
Evaluate	-	-	-	20	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C504.1	3	2	2											
C504.2	2	2	2								2	2		
C504.3	3	3	2								2			
C504.4	3	3	2	2	2				1		2	3		
C504.5	3	3	2						1		2			
C504.6	3	2	2						1		2	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME505	CAD/CAM LABORATORY	1/0/3/2.5
Nature of Course	Practical application	
Pre Requisites	Engineering Drawing	

Course Objectives:

1	To understand and interpret drawings of machine components for preparing the assembly drawings using standard CAD packages.
2	To gain practical experience in handling 3D modeling software system.
3	To understand and interpret program codes for manufacturing different machine components using standard CAM systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C505.1	Recall the fundamentals of computer applications in design and manufacturing.	[R]
C505.2	Understand the features of computer packages.	[U]
C505.3	Sketch the machine components and assemblies before their actual fabrication.	[Ap]
C505.4	Prepare part programming for a CAD model.	[Ap]
C505.5	Generate the machining codes automatically using the CAM system.	[A]
C505.6	Study fabrication of components using RPT machine.	[U]

Course Content:

Recent trends in CAD/CAM, features of solid modeling packages, CNC technology, codes for part programming, MRP I, MRP II, 3D Printing, Group technology.

S. No	List of Exercises (Using appropriate softwares)	CO Mapping	RBT
1	Introduction to CAD & CAM software packages.	C505.2	U
2	3D Modelling of simple components like V Block, corner bracket etc.	C505.3	[Ap]
3	3D Modelling and assembly of Connecting rod.	C505.3	[Ap]
4	3D Modelling and assembly of Pedestal bearing.	C505.3	[Ap]
5	3D Modelling and assembly of Tail stock.	C505.3	[Ap]
6	Manual part programming using G and M codes for turning, step turning, taper turning, multiple turning, facing, multiple facing, thread cutting and radius turning on cylindrical components.	C505.4	[A]
7	CNC Milling program involving linear motion and circular interpolation.	C505.4	[A]
8	CNC Milling program involving contour motion and canned cycles.	C505.4	[A]
9	Simulation of machining operations using CAM software.	C505.5	[A]
10	CNC code generation using CAM software.	C505.5	[A]
11	Study and practical demonstration on CNC Machine.	C505.4	[U]
12	Demonstration of real time engineering component fabrication using 3D printing machine.	C505.6	[U]
	Total Hours:		**45**

Reference Books:

1	Ibrahim Zeid, “CAD-CAM Theory and Practice”, McGraw-Hill Publishing Co. Ltd., 2015.
2	N.D. Bhatt, “Machine Drawing”, Charotar Publishing House Pvt. Limited., 2012.
3	Gopalakrishnan, K.R, ”Machine drawing”, Subash publishers, 2014.
4	Yoram Koren, “Computer Control of Manufacturing Systems”, McGraw-Hill Book Company, 2005.

Web References:	
1	http://www.mastercam.com/en-us/Support/Training/Certification
Online Resources:	
1	www.nptel.ac.in/video.php?subjectId=112102101

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	20	20
Understand	30	30
Apply	30	30
Analyze	20	20
Evaluate	-	-
Create	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C505.1	3	3	2									3	2	1
C505.2	3	3	2						2		1	3	2	1
C505.3	3	3	2	2					2		1	3	1	1
C505.4	3	3	2	2					2		1	3	1	1
C505.5	3	3	2						2		1	3	1	1
C505.6	3	3	2								1	3	2	1

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME506	MEASUREMENTS AND INSTRUMENTATION LABORATORY (Project Based Lab)	1/0/3/2.5
Nature of Course	Theory and Practical	
Pre requisites	Manufacturing Technology II	

Course Objectives:

1	To learn the fundamental concept of measurements for quality inspection.
2	To measure the dimensions of mechanical components using various measuring instruments.
3	To develop programs for applications using Lab View software.

Course Outcomes:

Upon completion of the course, students shall have ability to

C506.1	Understand the uses of basic measuring instruments.	[R]
C506.2	Perform the experiments to check linear and angular measurements.	[Ap]
C506.3	Interpret the dimensions of a given workpiece using comparator	[Ap]
C506.4	Develop programs for various applications using Lab View software.	[A]

Course Contents:

Generalized measuring system, Limits, fits and tolerances - Linear measuring instruments, Angular measuring Instruments, Comparators, Interferometers, Autocollimator, Gear terminologies and different measuring methods - Surface finish: straightness, flatness and roundness measurements, Study – Tool maker's microscope - Coordinate measuring machine - Precision instruments based on laser principles - Basics of Virtual Instrumentation (VI) - Creating VI for simple applications.

Laboratory Components:

S. No	List of Experiments	CO Mapping	RBT
1	Measure the given workpiece using vernier caliper.	C506.2	[Ap]
2	Measure the height of the given component using vernier height gauge.	C506.2	[Ap]
3	Measure the Depth of the given component using vernier depth gauge.	C506.2	[Ap]
4	Measure gear tooth thickness using gear tooth vernier caliper.	C506.2	[Ap]
5	Measure the diameter of the given workpiece using micrometer.	C506.2	[Ap]
6	Measure the unknown angle of the work piece using sine bar and slip gauges.	C506.2	[Ap]
7	Measure the surface waviness of the given specimen using a mechanical comparator.	C506.3	[Ap]
8	Tool angle measurement using Tool maker's microscope.	C506.2	[Ap]
9	Study of Virtual instrumentation for simple applications.	C506.4	[U]
10	Simulate the basic arithmetic and logic operations using VI.	C506.4	[A]
11	Simulate the temperature alarm using VI.	C506.4	[A]
	Total Hours:		**45**

Reference Books:

1	Sanjay Gupta and Joseph john, "Virtual Instrumentation using Labview", Tata Mcgraw Hill Publishing Co Ltd, 2014.
2	R.K Jain, 'Engineering Metrology', 21st edition, Khanna Publishers, 2012.
3	I.C Gupta, 'A text book of Engineering Metrology', 5th edition, Danapat rai & Co, 2012.
4	Alsutko, Jerry D Faulk, 'Industrial Instrumentation', 4th edition, Cenage asia Private Ltd., 2011.

Web References:	
1	http://www.nplindia.in/research-areas
Online resources:	
1	https://nptel.ac.in/courses/112106179/
2	http://www.ni.com/en-in/shop/labview/labview-details.html

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	20	20
Understand	20	20
Apply	40	40
Analyze	20	20
Evaluate	-	-
Create	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C506.1	3	3	3		3		3		3	2		1		
C506.2	3	3	2		3		3		3	2		1		
C506.3	3	3	3		3		3		3	2		1		
C506.4	3	3	3		3		3		3	2		1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME601	DESIGN OF TRANSMISSION SYSTEMS (Project Based Course)	3/0/1/3.5
Nature of Course	Theory analytical	
Pre Requisites	Design of Machine Elements	
Course Objectives:		
1	To understand the different types of flexible transmission systems.	
2	To understand the terminology, geometry and basic kinematic concepts of gears.	
3	To learn the design of brakes, clutches and gear box.	
4	To enable the students to design real time transmission system elements.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C601.1	Recall the basic design concepts of transmission systems.	[R]
C601.2	Select standard data from design data book and manufacturers catalog.	[U]
C601.3	Calculate and analyze the stresses in the transmission elements.	[A]
C601.4	Apply the standard design procedure and design the transmission elements.	[Ap]
C601.5	Design, fabricate and evaluate a model of the transmission system.	[C]

Course Contents:

Design of Transmission Systems of Flexible Elements: Belt Drives, Selection of V belts and pulleys, flat belts and pulleys, Introduction to toothed belts, design of chain drives and sprockets.

Spur Gears And Helical Gears: Spur gear – Design of spur gear based on strength and wear considerations. Parallel axis helical gears - force, beam strength, wear strength and design of helical gear. **Bevel and Worm Gears:** Straight bevel gear – Beam strength, wear strength, tooth force analysis, design of bevel gears. Worm Gear – force, stresses, thermal capacity, estimating the size of the worm gear pair.

Design of Gear Boxes: Step ratio, ray diagram, kinematics layout. Design of sliding mesh gearbox, constant mesh gear box, multi speed gear box, Theory of variable speed gear box, Introduction to fluid couplings and Torque converters for automotive applications. **Design of Clutches and Brakes:** Clutches, Design of clutches – Plate clutches–Axial clutches-Cone clutches, Electromagnetic clutches. Brakes – Design of block brake, band brakes, disc brakes.

Total Hours:	**60**

Text Books:	
1	Bhandari, V.B., “Design of Machine Elements”, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd., 2017.
2	Juvinall R. C., Marshek K.M., “Fundamentals of Machine component Design”, 5th Edition, John Wiley & Sons Third Edition, 2016.
Reference Books:	
1	Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Tenth Edition, Tata McGraw-Hill, 2015.
2	Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2015.
3	Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”, 2nd Edition, McGraw-Hill Book Co., 2014.
Web References:	
1	https://nptel.ac.in/courses/112105124/39
Online Resources:	
1	https://www.coursera.org/learn/machine-design1
2	https://ocw.mit.edu/courses/mechanical-engineering/2-75-precision-machine-design-fall-2001/index.htm

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C601.1	Remember	Assignment/Quiz	6
C601.2	Understand		
C601.3	Analyze	Group Assignment	4
C601.4	Apply		
C601.5	Create	Mini Project	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	10	10	10	10
Understand	30	20	20	20
Apply	40	50	50	40
Analyze	20	20	20	30
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C601.1	3	2	3		3							3	1	
C601.2	3	3	3		3							3	1	
C601.3	3	3	3		3			2				3	1	
C601.4	3	3	3		3			3			1	3	1	
C601.5	3	3	3	2	3		2	2			1	3	1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME602	COMPUTATIONAL MECHANICS	3/0/0/3
Nature of Course	Theory Analytical	
Pre Requisites	Integral Calculus and Laplace Transform, Strength of materials, Fluid mechanics and machinery with lab	

Course Objectives:

1	To enable the students to understand the principle involved in discretization and the purpose of stiffness matrices and force vectors.
2	To enable the students to understand the applications of finite element analysis for solving engineering problems.
3	To create confidence to solve complex problems in the field of fluid flow among students.

Course Outcomes:
Upon completion of the course, students shall have ability to

C602.1	Summarise the governing equations for continuum and implementation aspects of FEA and CFD.	[U]
C602.2	Apply the appropriate element for the given structural problems.	[Ap]
C602.3	Numerically solve for stresses, strains and deformation of a structural component due to axial load, transverse load and bending, acting individually or in combination.	[A]
C602.4	Evaluate time-dependent and/or non-linear problems by applying various discretization methods and technologies in finite element methods.	[E]

Course Contents:

Introduction: Historical background, application to the continuum, governing equations for continuum, discretization, matrix algebra, weighted residual method, Ritz method, finite element software packages - advantages and limitations.

One Dimensional Elements: General procedure of FEM, coordinates and shapes functions, quadratic shape functions, Galerkin's approach-Element stiffness matrices and load vector, finite element equations: 1D-bar, beam and plane truss elements, Temperature effects. **Two Dimensional Elements**: Triangular Element (CST), Axisymmetric triangular element, Isoparametric elements-four node quadrilateral element, shape functions, element stiffness matrix and force vector, numerical integration.

Introduction to CFD: Purpose – Applications - Fundamental physical principles, Models of the flow - Governing equations of fluid dynamics – the continuity, momentum and energy equations (for an infinitesimally small fluid element moving with the flow).

Total Hours: 60

Text Books:

1	Logan D.L, "A First Course in the Finite Element Method", Thomson Learning, Fifth Edition, Cengage learning India pvt ltd, 2012.
2	Muralidhar.K, Sundararajan.T, "Computational fluid flow and heat transfer", Second edition, Narosa publishers, 2014.

Reference Books:

1	Tirupathi R. Chandrupatla and Ashok D. Belugundu, "Introdution to Finite Elements in Engineering", Pearson publications, 2015.
2	John D. Anderson, Jr, "Computational fluid dynamics," Indian Edition, McGraw Hill Education, 2012.

Web References:

1	http://www.nptel.ac.in/courses/105105041/1
2	http://nptel.ac.in/courses/112105045/

Online Resources:	
1	https://www.edx.org/course/hands-introduction-engineering-cornellx-engr2000

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C602.1	Understand	Online Quiz	5
C602.2	Apply	Simulation Exercise	5
C602.3	Analyze	Poster Presentation/ Assignment	5
C602.4	Evaluate	Tutorial/Group assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	20	20	20	20
Apply	30	30	30	30
Analyze	30	30	30	30
Evaluate	10	10	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C602.1	3	1		1						1		3	1	
C602.2	3	2			3					1	1	3	1	
C602.3	3	2	3		3						3	3	1	
C602.4	3	2	1								3	3	1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME603	MECHATRONICS LABORATORY	1/0/3/2.5
Nature of Course	Practical Application	
Pre requisites	Measurements and instrumentation laboratory, Fluid Mechanics and Machinery (with lab), CAD/CAM laboratory	

Course Objectives:

1	To learn industrial automation using hydraulics and pneumatics circuits.
2	To understand and classify the advantages in automation using of Sensors, PLC and Robotics.
3	To train the students in the different aspects of Sensors, PLC programming languages and robot languages.

Course Outcomes:
Upon completion of the course, students shall have ability to

C603.1	Understand the hydraulic and pneumatic circuits for industrial applications.	[U]
C603.2	Create and stimulate hydraulic and pneumatic circuits	[C]
C603.3	Understand the concepts of sensors, PLC and Robotics.	[U]
C603.4	Select suitable Sensors, PLC & Robot for specific application.	[Ap]

Course Contents:

Introduction to Sensors and Transducers ,Performance and Terminology, Sensors for Displacement, Position and Proximity, Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature sensor, Light Sensors – Selection & Applications of Sensors.
Introduction to PLC, Basic structure, I/O Processing, Timers, Timers, Internal relays and counters, Shift Registers, Master and Jump Controls, Data Handling, Analog Input / Output, Programming and mnemonics, Selection of PLC & Applications. Robotics – Introduction, Anatomy of robots, Classifications of robot, parts of robot – Manipulator, End effector, Actuator, Sensors, Power supply, robot programming means, application of robot.

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Design and Simulation of pneumatic circuit for actuating single and double acting cylinder.	C603.1	[U]
2	Design and Simulation of Logical functions (AND, OR) for control of double acting cylinder.	C603.2	[C]
3	Design and Simulation of metering-in and metering-out circuits.	C603.2	[C]
4	Pneumatic circuit for single cycle automation of multi cylinder in sequence of A+B+B-A- using cascade method.	C603.2	[C]
5	Measurement and control of temperature, pressure and flow using sensors in process station.	C603.3,4	[Ap]
6	Measurement of displacement using LVDT	C603.3,4	[Ap]
7	Measurement of torque using Torque Measurement device	C603.3,4	[Ap]
8	Measurement of pressure using bourdon gauge	C603.3,4	[Ap]
9	TCP teaching to Robot	C603.3,4	[Ap]
10	Teach the ABB six robot to identify the given component is metal or non metal using teach pendant	C603.3,4	[Ap]
11	Perform a matrix palletizing operation of ABB six axis robot	C603.3,4	[Ap]

	using teach pendant with single suction cup		
12	Electro pneumatic circuit using PLC	C603.3,4	[Ap]

Total Hours	**60**

Text Books:	
1	Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill Education, 2nd edition, 2012.
2	Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085",Penram International Publishing (India) Private Limited, 6th edition, 2013.
3	Antony Esposito, "Fluid Power with Applications", Pearson education, 7th editon, 2013.
4	Subrahmanyam, "Electric Drives: Concepts & Applications, Tata McGraw-Hill Education, 2nd edition, 2011.
Reference Books:	
1	R.K.Mittal, I.J. Nagrath, "Robotics and Control", McGraw Hill Education, 2017.
2	Zeev Bahir, "Electrical Drive Control: Textbook with Applicative Aspects", CreateSpace Independent Publishing Platform, 2015.
Web References:	
1	http://www.electrical4u.com/electrical-drives/
2	http://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.htm
Online Resources:	
1	http://nptel.ac.in/courses/108104011/
2	http://nptel.ac.in/courses/108107029/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	20	20
Understand	20	20
Apply	20	20
Analyse	10	10
Evaluate	10	10
Create	20	20

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C603.1	3	3	2	3	3	2					1	2		3
C603.2	2		3			2					2	1	2	3
C603.3	2	2				3					3	1	1	2
C603.4	3	3	2		3				2	3	2	2	1	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME604	SIMULATION AND ANALYSIS LABORATORY	0/0/3/1.5
Nature of Course	Problem experimental	
Pre Requisites	Problem solving Techniques and C programming, Computational Mechanics	

Course Objectives:

1	To enable students create model for a given component using software.
2	To impart knowledge to perform stress analysis for any given component under various mechanical loading conditions.
3	To enable the students to simulate and analyze engineering components under various thermal loading conditions.
4	To enable the students to verify the simple 2D flow using numerical coding.

Course Outcomes:
Upon completion of the course, students shall have the ability to

C604.1	Model of 3D machine components using analysis software.	[Ap]
C604.2	Solve the simple structural problems using analysis software.	[A]
C604.3	Analyze and evaluate the given component under thermal condition using analysis software.	[E]
C604.4	Validate simple flow problem through CFD analysis.	[E]
C604.5	Develop programs to simulate mechanical system.	[C]

Laboratory Components:

S.No	List of Experiments (Using analysis and simulation softwares)	CO Mapping	RBT
1	Stress analysis of L bracket/ Plate with Hole.	C604.1	[Ap]
2	Stress analysis of axisymmetric component.	C604.2	[A]
3	Stress analysis in Beam.	C604.2	[A]
4	Modal analysis of Beam.	C604.2	[A]
5	Thermal stress analysis in 2D components.	C604.2	[A]
6	Conductive and convective heat transfer analysis.	C604.3	[E]
7	Flow analysis for velocity and pressure distribution in simple 2D flow over flat plate.	C604.3	[E]
8	Flow and heat transfer analysis of fluid flowing in a rectangular duct and circular pipe.	C604.4	[E]
9	Verification and validation of laminar pipe flow.	C604.4	[E]
10	Simulation of air conditioning system with condenser temperature and evaporator temperatures as input to get COP.	C604.5	[C]
11	Simulation of hydraulic / pneumatic cylinder.	C604.5	[C]
12	Simulation of cam and follower mechanism.	C604.5	[C]

Reference Books:

1	Xiaolin Chen, Y. Yujin Liu, “Finite Element Modelling and Simulation using ANSYS Workbench”, CRC Press, 2015.
2	Sham Tickoo “ANSYS Workbench 14.0 for Engineers & Designers: A Tutorial Approach”, Dreamtech Press, 2012.
3	K.Muralidhar, T.Sundarajan, “Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 2014.
4	Soumitra Kumar Mandal, “Basic Electronics”, McGraw Hill Education India Private Ltd., 2013.
5	S.R.Otto,J.P.Danier. “An Introduction to Programming and Numerical Methods in MATLAB”, Springer, 2005.

Web References:	
1	https://www.nafems.org/e-learning/
2	http://www.mece.ualberta.ca/tutorials/ansys/
3	http://su2.stanford.edu/training.html
Online Resources:	
1	http://nptel.ac.in/courses/105103140/40
2	http://nptel.ac.in/courses/112105045/
3	https://www.coursera.org/learn/matlab
4	https://www.edx.org/course/hands-introduction-engineering-cornellx-engr2000x

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	10	10
Understand	10	10
Apply	20	20
Analyze	20	20
Evaluate	20	20
Create	20	20
Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	10	10
Understand	10	10
Apply	20	20
Analyze	20	20
Evaluate	20	20
Create	20	20

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C604.1	3	3	3		3				2	3	2	3	2	1
C604.2	3	3	3		3				2	3	2	3	2	1
C604.3	3	3	3		3		2		2	3		3	1	1
C604.4	3	3	2		3		2		2	3		3	1	1
C604.5	3	3	2		3				2	3	2	3	1	1

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME701	INDUSTRIAL ENGINEERING AND OPERATIONS MANAGEMENT	3/0/0/3
Nature of Course	Concept and Analytical	
Pre Requisites	Manufacturing Technology I & II	

Course Objectives:	
1	To create awareness about the basic industrial engineering concepts.
2	To understand and apply management principles, basics of quality and statistical quality control.
3	Ability to apply the suitable mathematical technique to solve the practical problems.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C701.1	Demonstrate knowledge on fundamental concepts of Industrial Engineering.	[U]
C701.2	Apply the quality concepts for continuous improvement.	[Ap]
C701.3	Solve the real world problems using suitable operation research technique.	[A]
C701.4	Make important business decisions using statistical and analytical methods.	[A]

INDUSTRIAL ENGINEERING AND MANAGEMENT: Industrial Engineering: Definition, Objectives and Techniques. Industrial Engineering application in service sectors. Productivity concepts and applications. Work study -concept and need, Method study procedure, Therbligs, Standard Time calculation: Stop-watch time study. Comparison of work measurement techniques.

QUALITY AND STATISTICAL QUALITY CONTROL: Introduction - Definition of quality - Dimensions of product and service quality - Contributions of Deming, Juran and Crosby. Continuous process improvement - PDCA cycle, 5S, Kaizen. The seven traditional tools of quality - Quality Function Development (QFD) – Failure mode and effect analysis (FMEA). Definition of SQC, benefits and limitation -Variation in process causes of variation –Theory of control chart- uses of control chart –Control Charts for X bar, R, np, p,c charts.

OPERATIONS RESEARCH: Introduction, LPP models: Formation-graphical solution – simplex algorithm. Transportation models: Feasible solutions (NW method- Least cost method- Vogels' approximation method) and Optimal solution by –MODI method. Project networks- PERT and CPM -critical path scheduling.

Text Books:	
1	Dale H. Besterfiled, et al., "Total quality Management", Pearson Education Asia, Fourth Edition, 2015.
2	Taha H.A, "Operation Research", Pearson Education sixth edition, 10th Edition, 2017.
3	Douglas C. Montgomery, Statistical Quality Control, 7th Edition 7th Edition, Kindle Edition, 2013.

Reference Books:	
1	Hira and Gupta, "Introduction to Operations Research", S.Chand and Co Ltd,, 2012.
2	Ravi V, "Industrial Engineering. & Management", PHI learning Pvt. Ltd, 2015.
3	Mahajan M , "Statistical Quality Control", Dhanpat Rai and Co, 2013.

Web References:	
1	https://www.accessengineeringlibrary.com/subject/industrial_engineering
2	http://asq.org/learn-about-quality/statistical-process-control/overview/tutorial.html

Online Resources:	
1	http:// freevideolectures.com › Mechanical › IIT Madras › Operations Research
2	https://www.sqconline.com/acceptance-sampling-course

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C701.1	Understand	Group Assignment	5
C701.2	Apply	Assignment	5
C701.3	Analyze		
C701.4	Analyze	Case study	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	40	30	20	20
Understand	40	50	30	30
Apply	20	20	30	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C701.1	3				3				1		3	3		
C701.2					3				1			3		
C701.3		3			3				2			3		
C701.4				1	3				2		2	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Elective subjects

18ME901	PRODUCT DESIGN AND DEVELOPMENT	3/0/0/3
Nature of Course	Theory	
Pre requisites	Design of Machine Elements, Manufacturing Technology	

Course Objectives:

1	To enable the students to gain knowledge on the process of product development based on customer needs.
2	To enable the students to understand the standard procedure available for concept development.
3	To facilitate the students to use design process and identify system level design issues.
4	To make the students familiarize with the intellectual property rights.

Course Outcomes:
Upon completion of the course, students shall have ability to

C901.1	Recall the basic product development process.	[R]
C901.2	Apply the design process for product development.	[Ap]
C901.3	Discover the IPR related issues and patent registration.	[U]
C901.4	Analyze the feasibility of the proposed project.	[A]

Course Contents:

INTRODUCTION: Product Development, Organizations. Development Process, Product Planning, Customer Needs, Product Life Cycle. **CONCEPT DEVELOPMENT**: Product and Target specification, various steps in concept generation, Brainstorming, Morphological analysis, Selection of concepts, EVAD (Design Evaluation) method, Principles of computer aided decision making.

DESIGN PROCESS Concept Testing, Response and Interpretation. Product Architecture, Platform planning, System level design issues. Embodiment design, Modelling, Robust design and DFx. **PLANNING FOR MANUFACTURE AND MANAGEMENT** Detail Design, Design Management, Project planning and control, Production design specification (PDS), Design review, Value analysis/engineering.

INTELLECTUAL PROPERTY RIGHTS AND PROJECT ECONOMICS Intellectual Property Rights, Write the description of the invention, Refine Claims, Pursue application. Economics and Management Accelerating Projects, Project Execution.

Total Hours:	**45**

Text Books:

1	G. E. Dieter, “Engineering Design”, McGraw – Hill International, 2013.
2	Ken Hurst, “Engineering Design Principles”, Elsevier Science and Technology Books, 2014.

Reference Books:

1	Karl T Ulrich & Steven D Eppinger, “Product design and development” New York, McGraw-Hill Education, 2016.
2	Kevin N A otto, Kritine I Wood, “Product Design”, Prentice Hall Publications, 2013.

Web References:

1	http://www.electrical4u.com/digital-electronics.htm
2	http://www.technologystudent.com/elec1/dig1.htm

Online Resources:

1	https://www.edx.org/course/product-design-delft-design-approach-delftx-dda691x-1

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C901.1	Remember	Objective type Quiz	5
C901.2	Apply	Assignment	5
C901.3	Understand	Technical Presentation	5
C901.4	Analyze	Group Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA - III [10 marks]**	
Remember	40	40	40	40
Understand	30	30	30	30
Apply	20	20	20	20
Analyse	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C901.1	2		3		3	2		3	2				3	
C901.2	2	3	3		3	2		1	2		3	3	2	
C901.3	3	3	3		3	2		3	3	2	3	2	2	
C901.4	1		3		2	3		2	3	2	3	2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME902	TOOL AND DIE DESIGN	3/0/0/3
Nature of Course	Concept and Analytical	
Pre requisites	Engineering Mechanics, Strength of Materials, Manufacturing Technology II	

Course Objectives:

1	To select suitable single point cutting tool and multipoint cutting tool for machining process.
2	Design of Jigs and Fixtures for holding tool and work price respective.
3	Design of dies and moulds for fabricating different shapes of components.
4	To communicate the different types of tool manufacturing process.

Course Outcomes:
Upon completion of the course, students shall have ability to

C902.1	Recognize the material properties, tool nomenclature and to categorize the cutting tools.	[U]
C902.2	Interpret the parameters of the cutting tools for machining process.	[Ap]
C902.3	Distinguish the various locating and clamping methods.	[A]
C902.4	Design the jigs, fixtures, press tools and moulds.	[C]

Course Contents:

Design of single point and multi point cutting tools Introduction to cutting tools, Materials properties, classification, selection, tool wear and tool life. Single point tools: Nomenclature, types, styles, design Multipoint cutting tools: Nomenclature, types, styles, design. Recent development in metal cutting: Hot machining, Rotary machining, High speed machining.

Design of jigs and fixtures Types of drill jigs, General considerations in the design of drill jigs, Drill bushings, Types, methods of construction. Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers, Pot Jigs**.** Design principles, Types of fixtures, Fixtures for machine tools: Lathe, Milling, Boring, Broaching, grinding, Assembly fixtures, Inspection and Welding fixtures. Tolerance analysis and error location.

Design of Press tools and moulds Design of die sets for, sheet metal components, simple, compound and progressive dies for, punching and blanking operations, Dies for drawing and bending operations, Selection of presses and tools, Awareness of various software for sheet metal operations, both for analysis and design. Basic construction of mould – Types of moulds – Mould parts – mould plates, sprue bush, locating ring, core and cavity, Guide pillar & guide bush, Bolsters, Types of Bolsters, Mould clamping methods, Mould lifting arrangements. Design of different circuits in mould design (cooling, pouring and flow circuits).

Total Hours:	**45**

Text Books:

1	Donaldson C., Lecain G.H. and Goold V.C. “Tool Design” McGraw Hill Education; 4 edition, 20 April 2012.

Reference Books:

1	David A. Stephenson, John S Agapiou, “Metal Cutting Theory and Practice (Manufacturing Engineering and Materials Processing)”, March 2016.
2	Mikell P Groover, “Fundamentals of Modern Manufacturing”, John Wiley and Sons, Singapore, January 2010.

Web References:

1	http://www.dimensionalacademy.com/courses/mechanical/machine-tool-drawing.html/

Online Resources:

1	http://www.toolingu.com/ilt/915101/Design-for-TOOL-DFT/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C902.1	Understand	Assignment	3
C902.2	Apply	Group Discussion	3
C902.3	Analyze	Term Paper/ Case Study	4
C902.4	Create	Mini Project	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	30
Understand	30	40	30	30
Apply	30	30	30	20
Analyze	20	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C902.1	2	3	2	1	2			2	1	2	3	3	2	
C902.2	2	2	3		3			1	1	3	3	3		
C902.3	3	3	3		2			1	1	2	3	3	1	
C902.4	3	3	3		3			1	1	2	3	3	2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME903	APPLIED HYDRAULICS AND PNEUMATICS	3/0/0/3
Nature of Course	Theory application	
Pre Requisites	Fluid Mechanics and Machinery	

Course Objectives:

1	To introduce the working of the fluid power components and their needs.
2	To enable the students to understand the operation of various fluid power circuits.
3	To enable the students to understand the concepts like synchronizing and sequencing for automation.
4	To prepare the students to design electro-pneumatic circuit and ladder diagrams.
5	To allow students to design and simulate the circuits.

Course Outcomes:
Upon completion of the course, students shall have ability to

C903.1	Recall the fundamentals of hydraulic and pneumatic systems	[U]
C903.2	Select the components and control elements for hydraulic and pneumatic systems as per the application.	[Ap]
C903.3	Analyze the scenario and provide suitable solution to the problems in hydraulic and pneumatic systems.	[A]
C903.4	Design customized circuits in hydraulics, pneumatics and servo systems for various industrial needs.	[C]

Course Contents:

Fluid power systems and Fundamentals: Introduction to fluid power, advantages of fluid power, application of fluid power system. Types of fluid power systems, properties of hydraulic fluids, general types of fluids, fluid power symbols. Basics of hydraulics, applications of Pascal's Law, laminar and turbulent flow, Reynolds's number, Darcy's equation, losses in pipe, valves and fittings. **Hydraulic System and Components:** Sources of Hydraulic Power-Pumping theory pump classification, gear pump, vane pump, piston pump. Construction and working of pumps, pump performance, variable displacement pumps. Fluid Power Actuators, Linear hydraulic actuators, types of hydraulic cylinders, single acting, double acting special cylinders like tandem, rod less, telescopic, cushioning mechanism. Construction of double acting cylinder, rotary actuators, fluid motors, gear, vane and piston motors.

Design of Hydraulic Circuits: Construction of Control Components, Directional control valve , 3/2 way valve , 4/2 way valve, shuttle valve, check valve, pressure control valve, pressure reducing valve, sequence valve, flow control valve, fixed and adjustable, electrical control solenoid valves, relays, ladder diagram. Accumulators and Intensifiers, types of accumulators, accumulator's circuits, sizing of accumulators, intensifier, applications of intensifier, intensifier circuit, control of single, double hydraulic, regenerative, sequencing, synchronizing, continuous reciprocation, speed control, fail-safe circuit, control of hydraulic motor.

Pneumatic System and Components: Pneumatic Components, Properties of air, compressors, filter, regulator, lubricator unit, air control valves, quick exhaust valves, and pneumatic actuators. Control of single, double pneumatic, sequencing, semi-automatic, automatic, speed control, synchronizing circuit, pneumatic motor, pneumo-hydraulic circuit, sequential circuit design for simple applications using cascade method. **Design of Fluid Power Circuits:** Servo systems, Hydro mechanical servo systems, electro hydraulic servo systems and proportional valves, Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits, failure and troubleshooting. **Case studies:** A simple sequence, synchronizing circuits using hydraulic and pneumatic components.

Total Hours:	**45**

Text Books:	
1	Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2013.
2	Manjumdar S.R, “Oil Hydraulics”, Tata McGraw-Hill, December 2002.
Reference Books:	
1	Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 2010.
2	Bolton W. “Pneumatic and hydraulic system”, Butterworth-Heinemann 1997.
3	Andrew Parr, “Hydraulic and Pneumatics”, Jaico Publications House, 2005.
4	James L. Johnson, “Introduction to Fluid Power”, Delmar/Thomson Learning, 2003.
Web References:	
1	http://www.nfpa.com
2	http://www.fluidpowerjournal.com
3	http://14.139.160.15/courses/112102011/2

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C903.1	Understand	Assignment	5
C903.2	Apply	Assignment	5
C903.3	Analyze	Mini project/simulation of circuits	10
C903.4	Create		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	10	10
Understand	40	40	30	30
Apply	40	40	30	30
Analyze	-	-	20	20
Evaluate	-	-	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C903.1	3	3	2	3	3	2					1	2		
C903.2	2		3			2					2	2		2
C903.3	2	2				3					3	1		2
C903.4	2	2		3	2	2					3	2		3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME904	DESIGN FOR MANUFACTURING AND ASSEMBLY	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Manufacturing Technology II	

Course Objectives:

1	To enable the students to understand the general design guidelines of design for manufacture and assembly.
2	. To provide the knowledge on minimising the cost/time, maximising the quality and ease of manufacture and assembly.
3	. To enable the students to understand the principles and design rules for the design for casting, welding and machining.
4	. To outline the features of DFMA software.

Course Outcomes:

Upon completion of the course, students shall have ability to

C904.1	. Summarize the design procedure of engineering products in order to minimize the cost/time.	[U]
C904.2	. Analyse the importance of tolerance and process capability in promoting interchangeability and selective assembly.	[A]
C904.3	. Analyze the design process of engineering products for ease of assembly and machining.	[A]
C904.4	. Apply the design concepts for engineering products for casting, welding and machining operations.	[Ap]
C904.5	. Study the design parameters of a product using DFMA software	[U]

Course Contents:

DFMA Introduction: Engineering design – Kinds of design – Design process steps – Factors influencing design – Concurrent Engineering – Material selection process – Evaluation methods for material selection. Tolerance analysis: Process capability analysis – Cumulative effect of tolerances – Centrality analysis – Compound assembly – Selective and Interchangeable assembly – Grouped Datum systems – Geometric Dimensioning &Tolerances: Symbols – Feature Control frame – Virtual Tolerance.

Design for casting, welding and machining: Design for castings – Design for weldments – Design for forgings – Design for sheet metal formed parts – Design for powder metallurgy parts – Design for plastic parts. Design for machining – Design for economy – Design for clampability – Design for ease of assembly – Design for disassembly.

DFMA software: Advances in DFMA- Design for robustness – Axiomatic design – Design for environment – DFA index – Poka Yoke – Lean principles – Six sigma concepts – Computer aided DFA using software.

Total Hours:	**45**

Text Books:

1	Matousek, R. “Engineering Design” Blackie and Son Limited, Glasgow, 2015.
2	Dieter, G.E. “Engineering Design: A Materials and processing Approach”, McGraw Hill Co. Ltd, 5th edition, 2012.

Reference Books:

1	Eggert, R.J. “Engineering Design” Pearson Education, Inc. New Jersey, 2014.
2	Peck, H. “Designing for Manufacture”, Pitman Publications, London, 2013.
3	KalandarSaheb, S.D and Prabhakar, O. “Engineering Design for Manufacture”, ISPE 2014.
4	Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, “Product design for manufacture and assembly”, Second edition, Taylor and Francis, 2015.

Web References:	
1	www.dfma.com
Online Resources:	
1	www.nptel.ac.in/courses/107103012
2	www.mjme.ir -International journal of advanced design and manufacturing

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C904.1	Understand	Class presentation	5
C904.2	Analyze		
C904.3	Analyze	Assignment	5
C904.4	Apply		
C904.5	Understand	Case study using DFMA software	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	10
Understand	20	20	20	30
Apply	20	30	30	30
Analyse	20	20	20	20
Evaluate	20	10	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C904.1	2	3		2	2	2	2	2	2	2		3	2	
C904.2	3	3		2	3	2	2	2	2	2		3	2	
C904.3	3	2		2	3	2	2	2	2	2		3	2	
C904.4	3	2		3	2	2	2	3	3	2		3	3	
C904.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME905	OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN	3/0/0/3
Nature of Course	Theory analytical	
Pre requisites	Industrial Engineering and Operations Management	
Course Objectives:		
1	To enable the students to have an in-depth knowledge about the optimization techniques applied to industrial operations.	
2	To make the students understand and apply optimization techniques to real world problems.	
3	To make the student develop the mathematical techniques and algorithms to practical problems.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C905.1	Implement the basics of optimization techniques to engineering problems.	[U]
C905.2	Formulate and solve non-linear programming problems.	[Ap]
C905.3	Solve integer programming and dynamic programming problems.	[A]
C905.4	Apply non-traditional techniques to managerial problems.	[E]
Course Contents:		
Non Linear Optimization: Introduction to Non-linear optimum design-General principles of optimization–Problem formulation & their classifications. Single variable and multivariable optimization. Non-linear Optimization with equality and inequality constraints. Direct methods–Indirect methods using penalty functions. Lagrange multipliers -Geometric programming**.** **Integer Programming Problems:** Introduction- Integer Programming formulations. Branch and bound technique. Gomary's cutting plane method. **Dynamic Programming Problems:** Introduction to Dynamic Programming (DP) - Bellman's principle of optimality. Application of DP-Capital budgeting, Reliability improvement. Shortest path and cutting stock problems. **Nontraditional Optimization:** Introduction to non-traditional optimization, Computational Complexity – NP-Hard and NP-Complete. Taguchi method, Working principles of Genetic Algorithm, Simulated Annealing and Particle Swarm Optimization, Introduction to Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Neural network applications: Process identification, control, fault diagnosis and load forecasting.		
	Total Hours:	**45**
Text Books:		
1	Taha H.A, "Operation Research", Pearson Education sixth edition, 10th Edition 2017.	
2	Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall India (Pvt) Ltd., New Delhi, 2012.	
Reference Books:		
1	D.K. Pratihar and S.P. Simon, Soft Computing techniques, Oxford University Press, 2015.	
2	S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2012.	
Web References:		
1	http://growingscience.com/beta/msl/570-non-conventional-optimization-techniques-in-optimizing-non-traditional-machining-processes-a-review.html	
Online Resources:		
1	https://www.coursera.org/learn/algorithms-npcomplete	
2	http//www.nptel.ac.in/downloads/105108127	

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C905.1	Understand	Quiz	5
C905.2	Apply	Tutorial	5
C905.3	Analyze	Case Study	5
C905.4	Evaluate	Group Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	10	10	10	10
Understand	20	20	20	10
Apply	20	20	10	20
Analyze	30	40	40	40
Evaluate	20	10	20	20
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C905.1	3				3				1		3	3		
C905.2		3			3				1			3		
C905.3					3				2			3		
C905.4				1	3				2		2	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME906	INDUSTRIAL ROBOTICS	3/0/0/3
Nature of course	Concept and Theory	
Pre requisites	Engineering Mechanics, Kinematics of Machinery	

Course Objectives:

1	To be familiar with the industrial automation and brief history of robot and its application.
2	To enable the students to familiarize with the kinematics of robots.
3	To impart knowledge on robot end effectors, arm and their design.
4	To enable the students to write programs for Robot
5	To impart knowledge on various sensors and their applications in robots.

Course Outcomes:

Upon completion of the course, students shall have ability to

C906.1	Summarize the types, principles and applications of industrial robots and sensors	[U]
C906.2	Elaborate the types of robotic manipulators and gripper configuration based on kinematics and dynamics of robot.	[U]
C906.3	Analyse the drive mechanism and power transmission methods used in robots.	[A]
C906.4	Design the various components of a robot by applying the learnt concepts such as kinematics, transmission and control mechanism, sensors and programming language.	[C]

Course Contents:

Introduction to Robot, Kinematics and dynamics: Robot definition: Robotic systems - Its role in automated manufacturing; robot anatomy; robot classifications and specifications - Types of industrial robots - Work envelope - Flexible automation versus Robotic technology – Applications of Robots. Translations, Rotations and Transformations - Forward and reverse transformation, homogeneous transformations - Forward and inverse Kinematics Of three & four Degree of Freedom Robot Arm. Robot Arm dynamics. ABB – SCARA robot anatomy and it's working.

Robot drives, controls and power transmission: Robot drive mechanisms – hydraulic – pneumatic and electric, Mechanical transmission methods. Electronic and Pneumatic manipulators - Construction of Manipulators. Different Types of Controllers-Proportional, Integral, Differential, PID controllers. Classification of End effectors - Drive system for grippers-Mechanical-adhesive-vacuum-magnetic-grippers. Active and passive grippers.

Robot sensors, programming language and Industrial Applications Robot sensors, different types of contact and non-contact sensors. Robot languages and programming techniques**.** Robotic vision systems, image representation, object recognition and categorization, Role of artificial intelligence in robotics. Material transfer, Machine loading, Assembly, inspection, processing operations and service robots, Robots in continuous arc welding, Robot cell.

Total Hours:	**45**

Text Books:

1	Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2012
2	Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2012

Reference Books:	
1	Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 2009
2	M.P Groover, M Weiss, R M Gnagel and N G Ordrey, “Industrial Robotics”, Tata McGraw - Hill, New Delhi, 2012
Web References:	
1	http://www.robotics.org/
2	http://www.robotbooks.com/general-robotics-links.htm
Online Resources:	
1	https://www.edx.org/course/robotics-columbiax-csmm-103x
2	https://www.edx.org/course/robot-mechanics-control-part-i
3	https://www.edx.org/course/robot-mechanics-control-part-ii

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C906.1	Understand	Class Presentation/Assignment	5
C906.2	Understand	Quiz	5
C906.3	Analyse	Mini Project	10
C906.4	Create		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	20	20	30	30
Apply	40	30	30	30
Analyze	20	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C906.1	3	2	2	3	3					3		1		3
C906.2	3		3							2		1		3
C906.3	3		3							1				3
C906.4	3	1	3	2	2					3		1		3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME907	MECHANICAL VIBRATIONS	3/0/0/3
Nature of Course	Theory Analytical	
Pre Requisites	Engineering Mechanics, Kinematics of Machinery, Dynamics of Machinery	

Course Objectives:

1	To impart knowledge on vibrations and its types
2	To understand the experimental procedures of vibration measurement.
3	To study the control measures of vibrations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C907.1.	Understand the different types of vibrations and the related terms.	[U]
C907.2.	Develop schematic models for physical systems and formulate governing equations of motion for various vibrating systems.	[Ap]
C907.3.	Analyze and design supporting structures, vibration isolators and absorbers.	[A]
C907.4.	Examine the vibration control methods	[E]

Course Contents:

INTRODUCTION - Introduction-Causes and effects of vibration, Classification of vibrating system, Physical models, Schematic models and Mathematical models. **SDF systems**: Formulation of equation of motion: Newton –Euler method, De Alembert's method, Energy method, **FREE VIBRATION**: Undamped Free vibration response, Damped Free vibration response, Case studies on formulation and response calculation. **FORCED VIBRATIONS -** Forced vibration response: Response to harmonic excitations, solution of differential equation of motion, Magnification factor Resonance, Motion Transmissibility and Vehicular suspension.

TWO DOF SYSTEMS - Two degree of freedom systems: Introduction, Formulation of equation of motion, General solution to free vibration problem - damped free vibration - Forced vibration of undamped system -dynamic vibration absorbers - Technical applications. **MULTI DOF SYSTEMS** - Newton's second law to derive equation of motion, Influence co-efficient - Stiffness influence co-efficient - Flexibility influence co- efficient - Inertia influence co - efficient, Eigen values & Eigen vectors. Methods of finding Natural Frequencies for simple problems -Dunkley, Rayleigh's, Matrix iteration - Stodolo's methods. Matrix iteration method and Holzer's method.

EXPERIMENTAL METHODS IN VIBRATION MEASUREMENT & CONTROL Vibration Instruments, Vibration exciters and Measuring devices, Analysis, Vibration Tests, Free and Forced Vibration tests. Vibration Isolation methods - Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing. Introduction to FFT Analyzer.

Total Hours:	**45**

Text Books:

1	Singiresu S. Rao, Mechanical Vibrations, 6th Edition Prentice Hall Publish, New Delhi, 2017.
2	J. S. Rao , Vibratory Condition Monitoring of Machines, Narosa Publishing House, New Delhi, 2013.

Reference Books:

1	J. P. Den Hartog – Mechanical Vibrations, Caster press, 2013.
2	K.J.Bathe, Finite Element Methods,Prentice Hall, Pearson Education, Inc, 2016.

Web References:

1	www.conditionmonitoringsystem.com/

Online Resources:	
1	https://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/ve/index.htm

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C907.1 C907.2	Understand Apply	Individual Assignment / Case Study	5
C907.3	Analyze	Group Assignment	5
C907.4	Evaluate	Tutorials	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	20	10	10	10
Apply	20	30	30	30
Analyse	40	40	40	40
Evaluate	10	10	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C907.1.	3	3	2		3				2		3	3		1
C907.2.	3	3	3		3			2	2		2	3		1
C907.3.	3	3	3		3			2	3		2	3		2
C907.4.	3		3		2			2	1			3		2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME908	COMPOSITE MATERIALS AND MECHANICS	3/0/0/3
Nature of Course	Theory	
Pre Requisites	Metallurgy and Materials Testing	

Course Objectives:

1	Students will be able to understand the basic concepts and classifications of composite materials.
2	Students will be able to analysis micro & macro mechanical behaviour of composites.
3	Students will be able to understand the basics of smart materials.

Course Outcomes:

Upon completion of the course, students shall have ability to

C908.1	Define the basic concepts of composite materials.	[U]
C908.2	Illustrate the applications of smart materials.	[Ap]
C908.3	Analyse the micro and macro mechanical properties of lamina and laminates.	[A]
C908.4	Evaluate the fatigue, fracture and failure criteria of composite structures.	[E]

Course Contents:

INTRODUCTION: Modern materials in design, types, metals, polymers, ceramics, composites, Classification of composites, advantages, applications and limitations, Matrix and reinforcement-their roles, principal types of fibre and matrix materials. **MANUFACTURE OF COMPOSITE COMPONENTS:** Layup and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, injection moulding, blow moulding, an overview of metal matrix composite processing and ceramic matrix composite processing.

MICRO MECHANICAL BEHAVIOUR OF A LAMINA: Volume and mass fractions, evaluation of elastic moduli, strength of unidirectional lamina. **MACROMECHANICAL BEHAVIOUR OF A LAMINA**: Hooke's law for different types of materials, engineering constants for orthotropic materials. Stress, strain relations for plane stress in an orthotropic materials and in a lamina of arbitrary orientation, strength of an orthotropic lamina, basic strength theories.

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Classical lamination theory - lamina stress - strain behavior - types of laminates - strength and stiffness of laminates. **ANALYSIS OF COMPOSITE STRUCTURES**: Fatigue, Fracture mechanics-basic principles, fracture initiation, crack growth and crack growth modes, toughening mechanisms, Wear and Environmental effects, Composite joints-bonded, bolted and bonded-bolted joints. Tsai-Hill's Failure Criterion for Composites.

Total Hours:	**45**

Text Books:

1	Ronald F Gibson, "Principles of Composite Material Mechanics", McGraw Hill Book Co, 4th Edition, 2016.
2	Ever J Barbero, "Introduction to composite materials Design", CRC Press, 3rd edition, 2017.

Reference Books:

1	Robert M Jones, "Mechanics of Composite Materials", Taylor and Francis, 3rd Edition, 2015.
2	Autar K Kaw, "Mechanics of Composite Materials", CRC Press, NY, 2006.

Web References:

1	https://www.edx.org/course/composite-materials-overview-engineersuwashingtonx-aa432x

Online Resources:	
1	http://nptel.ac.in/courses/101104010/
2	https://www.online.colostate.edu/courses/MECH/MECH530.dot

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C908.1	Understand	Group Assignment	5
C908.2 & C908.3	Apply / Analyse	Poster Presentation	10
C908.4	Evaluate	Individual Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	30	30	30	30
Apply	40	40	30	30
Analyse	20	20	20	20
Evaluate	-	-	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C908.1	3											1	2	
C908.2	3		3									1	3	
C908.3	3	3	3		2							1	2	
C908.4	3	3	3		2							2	3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME909	ENGINEERING TRIBOLOGY	3/0/0/3
Nature of Course	Concepts and Analytical	
Pre requisites	Engineering Mechanics Fluid Mechanics and Machinery	

Course Objectives:

1	To provide greater insight into the science and technology of interacting surfaces in relative motion.
2	To study in detail about surfaces, friction, wear, lubrication and their effects.
3	To apply the concepts to the design of hydro dynamic, hydro static and rolling element bearings.

Course Outcomes:

Upon completion of the course, students shall have ability to

C909.1	Understand the fundamentals of friction, wear and lubrication.	[U]
C909.2	Illustrate the concept of wear and lubrication to solve inter-disciplinary engineering problems.	[Ap]
C909.3	Apply the concepts of lubrication to design the rolling element bearings.	[Ap]
C909.4	Correlate the surface coating techniques with nano tribology	[A]

Course Contents:

Friction and Wear - Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction - Friction of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction. Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

Lubrication and Film Lubrication Theory - Types and properties of Lubricants –Lubrication regimes-Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication-Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication. Fluid film in simple shear – Viscous flow between very close parallel plates – Shear stress variation Reynolds Equation for film Lubrication – High speed loaded/unloaded journal bearings-The Somerfield diagram.

Surface Engineering & Nano tribology - Surface modifications – Transformation Hardening, surface fusion – Thermo chemical processes – Surface coatings – Coating of polymers and plastics- Measuring techniques- Plating and anodizing – Fusion Processes – Vapour Phase processes. Nano tribology-Introduction, SFA studies- AFM/FFM studies-Atomic scale computer simulations.

Total Hours:	**45**

Text Books:

1	Bharat Bhusan, 'Introduction to Tribology', 2nd Edition, John Wiley & sons,Ltd.2013.
2	Harish Hirani, "Fundamentals of Engineering Tribology with Applications", Cambridge University Press, 2016.

Reference Books:

1	Ramsey Gohar "Fundamentals of Tribology" World Scientific Publishing Europe Ltd, 2018.

2	V.B.Bhandari “Design of Machine Elements “Third Edition. Tata McGraw hill Edition Pvt, 2012.
Online Resources:	
1	https://nptel.ac.in/courses/11210214/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C909.1	Understand	Quiz/Presentation	5
C909.2 C909.3	Apply	Group Assignment	5
C909.4	Analyze	Case study	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	30	30	30	30
Apply	40	40	40	40
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C909.1	3	1	3	1			1			1		3		
C909.2	3	2	3		3		2			1	1	2		
C909.3	3	2	3		3		2				3	3		
C909.4	3	2	3				2				3	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME910	NON-CONVENTIONAL ENERGY SOURCES	3/0/0/3
Nature of Course	Theory	
Pre Requisites	Engineering Thermodynamics Fluid Mechanics and Machinery Heat and Mass Transfer	
Course Objectives:		
1	To understand and analyze the various renewable energy resources and its environmental merits	
2	To discuss technologies for utilization of renewable energy sources	
3	To enable the students to understand the various economics involved in the utilization of renewable energy sources.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C910.1	List the various sources of renewable energy	[R]
C910.2	Describe the various means to utilize the renewable energy resources	[U]
C910.3	Interpret the impact of renewable energy resources on the environment	[Ap]
C910.4	Analyse the scope of newer sources of energy and their application	[A]
Course Contents:		

Role and potential of new and renewable source: the solar energy option– solar Cells – PV Systems, Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion, **Solar Radiation** – Measurements of solar Radiation and sunshine – PV Applications and state of the art applications like solar walls, solar refrigeration,

Energy available from wind: Basis of Wind energy conversion, Lift and drag, Effect of density, Angle of attack, Wind Energy generators and its performance – Wind Energy Storage – **Applications** – Hybrid systems – State of the art technology trends for offshore wind energy operation, Biomass, Biogas, Source, Composition, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, Bio gas production Aerobic and anaerobic bio-conversion process, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics. Photosynthesis, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production. Government Policy and Status of Bio fuel technologies in India

Power plants based on ocean energy: Principle of ocean thermal energy conversion, Open and closed OTEC Cycles, Problems associated with ocean thermal energy conversion systems –Small hydro turbines, **Geothermal energy sources**, power plant and environmental issues – potential in India, Fuel cells – technologies, types – economics and power generation, Sonofusion – energy from bubbles, Magneto-hydro-dynamic (MHD) energy conversion, Fuel from sea – concept, Green islands- Canary island.

Total Hours:	**45**

Text Books:	
1	G.D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011
2	S.P. Sukhatme, J K Nayak, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
Reference Books:	
1	C. Godfrey Boyle, “Renewable Energy - Power for a Sustainable Future”, Oxford University Press, U.K., 2012
2	D. Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2015
3	E.G.N. Tiwari, “Solar Energy – Fundamentals Design, Modelling& applications”, Narosa Publishing House, New Delhi, 2012

Web References:	
1	https://www.udemy.com/climate-change-and-renewable-energy

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C910.1	Remember	Group Assignment	5
C910.2	Understand	Presentation	5
C910.3	Apply	Individual Assignment	5
C910.4	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	30	30
Understand	30	30	30	30
Apply	30	30	30	30
Analyse	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C910.1								2	1		3	1		
C910.2			1					3	2			2		
C910.3								3	1		3	3		
C910.4			1					3	1			3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME911	REFRIGERATION AND AIR CONDITIONING	3/0/0/3
Nature of Course	Theory analytical	
Pre Requisites	Engineering Thermodynamics Thermal Engineering.	

Course Objectives:	
1	To understand the vapour compression and vapour absorption system operation.
2	To analyse the refrigeration cycles and methods for improving their performance.
3	To familiarize the components of refrigeration system.
4	To design air conditioning systems using cooling load calculations.
5	To know the application of refrigeration and air conditioning systems.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C911.1	Describe the principles and applications of refrigeration and air conditioning systems.	[R]
C911.2	Differentiate the various types of refrigeration and air conditioning systems.	[U]
C911.3	Calculate the performance of refrigeration and air conditioning systems.	[Ap]
C911.4	Analyse the methods to improve the performance of refrigeration and air conditioning systems.	[A]

Course Contents:

Introduction to Refrigeration – Basic Definition, **Air Refrigeration Cycles**-,Bell-Coleman cycle analysis, Air Refrigeration systems-simple air cooling system and boot strap air cooling system (descriptive), merits and demerits.

Vapour Compression Refrigeration system and Vapour Absorption Refrigeration Systems – Vapour Compression system - Working and analysis, Limitations, Effects of sub cooling and super heating, Compound Vapour Compression Refrigeration Systems (descriptive). **Vapour Absorption Refrigeration Systems (Descriptive)**-Water-Ammonia Systems, Water-Lithium Bromide System, Contrast between the two systems, Modified System with Rectifier and Analyzer Assembly, Absorbent – Refrigerant combinations.

Refrigeration System Equipments and Air Conditioning Systems - Classification, Selection and Nomenclature of refrigerants. Refrigeration systems Equipment - Compressors, Condensers, Expansion Devices and Evaporators, Testing and charging of refrigeration units. **Air Conditioning Systems-** Different Air-Conditioning Systems – Central Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Components related to Air-Conditioning Systems, Mathematical Analysis of Air-Conditioning Loads, introduction to HVAC systems (descriptive), air conditioning in automobiles and Trains.

Total Hours:	**45**

Text Books:	
1	Arora,C.P.,"Refrigeration and Air Conditioning", Third edition, Tata McGraw Hill, New Delhi, 2012
2	Ananthanarayanan.P.N, "Basic Refrigeration and Air Conditioning", Tata McGraw Hill, 5th edition, New Delhi, 2013.

Reference Books:	
1	Manohar Prasad, "Refrigeration and Air conditioning", New Age International (P) Ltd, New Delhi, 2010.
2	Arora.S.C and Domkundwar.S, "A course in Refrigeration and Air conditioning", DhanpatRai (P) Ltd., New Delhi, 2012

Online Resources:	
1	http://nptel.ac.in/courses/112105128/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C911.1	Remember	Quiz	5
C911.2	Understand	Presentation	5
C911.3	Apply	Group Assignment	5
C911.4	Analyze	Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	30	30	30	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C911.1	3											2		
C911.2	3											3		
C911.3	3	2	3		3	2		3	2	2	2	3		
C911.4	3	3	3		3	2		3		2	2	3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME912	ALTERNATE ENERGY SOURCES FOR AUTOMOBILES	3/0/0/3
Nature of Course	Theory technology	
Pre requisites	Engineering Thermodynamics Thermal Engineering	
Course Objectives:		
1	To be aware of the available alternate energy resources.	
2	To recognize the ways of implementing the resources.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C912.1	Interpret the need, availability and difficulty in using alternate fuel.	[U]
C912.2	Analyze properties of alternate fuels and know the standards followed.	[A]
C912.3	Analyze the performance and emission characteristics of engines using alternate fuels.	[A]
C912.4	Discover the developments in hybrid energy and fuel cells.	[Ap]
Course Contents:		
Introduction: Need for alternate fuel Availability, Properties of alternate fuels, general use of alcohols, LPG, hydrogen, CNG, LNG. **Alcohols:** Properties of engine fuel, alcohols and gasoline blends, Performance, combustion characteristics and Emission characteristics in SI and CI engine. **Natural Gas, LPG, Hydrogen and Biogas:** Availability of CNG, Properties, modifications required to use in engines, Performance and emission characteristics of CNG and LPG in SI and CI engines, Hydrogen storage and handling, performance and safety aspects. **Renewable Oils:** Esterification, Performance and emission characteristics in engines. Hybrid oils in engines**.** **Electric, Hybrid, Fuel Cell and Solar Cars:** Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicle.		
	Total Hours:	**45**
Text Books:		
1	Amit Sarin, “Biodiesel- Production and Properties”- RSC Publishing - ISBN:978-1-84973-470-7, 2012.	
2	Sunggyu Lee, James G. Speight, Sudarshan K. Loyalku- “Handbook of Alternative Fuel Technologies”- CRC Press- 2015	
Reference Books:		
1	James D. Halderman, “Hybrid and Alternative Fuel Vehicles”- Pearson publication-2015	
2	Curtis D. Anderson and Judy Anderson, “Electric and Hybrid Cars- A History”- McFarlad & Company, Inc, Publishers- 2010.	
Web References:		
1	https://nptel.ac.in/courses/112104033/39	
2	https://fueleconomy.gov/feg/current.shtml	
Online Resources:		
1	https://afdc.energy.gov/fuels/	

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C912.1	Understand	Online Quiz	5
C912.2	Analyze	Assignment	5
C912.3	Analyze	Group Assignment	5
C912.4	Apply	Case Study	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination (50 Marks)**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	10	20	20
Understand	30	40	30	30
Apply	40	40	30	30
Analyse	10	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C912.1	3	2	3		1						3	1		
C912.2	2	3		2	3				3			3		
C912.3	3	3			3			3	2		2	3		
C912.4	3		2		3						3	2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME913	TURBO MACHINES	3/0/0/3
Nature of Course	Theory analytical	
Pre requisites	Engineering Thermodynamics Thermal Engineering	

Course Objectives:

1	To study the concept of unified theory applicable for all turbo machines.
2	To impart the fundamental knowledge about the design variations of turbo machines.
3	To design and develop the turbo machines.

Course Outcomes:
Upon completion of the course, students shall have ability to

C913.1	Understand the basics of turbo machines including dimensional analysis	[U]
C913.2	Apply the concept of velocity triangle in determining the performance of the turbo machines	[Ap]
C913.3	Analyse the efficiencies and losses in the performance characteristics of the turbo machines	[A]
C913.4	Evaluate the power and operational characteristics of the turbo machines	[E]

Course Contents:

Introduction: Thermal Turbo machines, Classification, General energy equation, Velocity triangles, Work, T-S and H-S diagram, Dimensional analysis, Non-dimensional parameters of compressible flow Turbo machines, Similarity laws. Role of turbo machines in present and future industries.

Compressors: classifications, Constructional details, Stage velocity triangles, H-S diagram, Stage efficiencies and losses, Surging and Stalling, Performance characteristics **Pumps**- Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - Cavitation, **Axial flow pumps** – Characteristics - Constructional details - Non-dimensional parameters – Efficiencies - Vibration and Noise in hydraulic pumps.

Wind turbines: Definition and classifications, Constructional details, Horizontal axis wind turbine, Power developed, Axial thrust and Efficiency. Turbo expander, Turbo prop, Mixed flow compressor.

Total Hours:	**45**

Text Books:

1	Yahya, S M, Turbines Compressors and fans, 4th edition, Tata McGraw-Hill, 2010.
2	Dixon, S L, Fluid Mechanics and Thermodynamics of Turbo machinery 7th Edition, Elsevier Butterworths Heinemann, 2014.

Reference Books:

1	Cohen H, Rogers,G F C and Saravan motto H I H, Gas Turbine Theory, John Wiely, 6th Edition 2013.
2	Ganesan, V., Gas Turbines, Tata McGrawHill, 2011.
3	Prithvi Raj, D and Gopalakrishnan, G, “A Treatise on Turbomachines”, Scitech publication, 2003.

Web References:

1	www.academia.edu

Online Resources:

1	https://nptel.ac.in/courses/112106200/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C913.1	Understand	Quiz	5
C913.2	Apply	Assignment	5
C913.3	Analyse	Assignment/Case Study	5
C913.4	Evaluate	Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	30	30	30	30
Understand	20	20	20	20
Apply	30	30	30	30
Analyse	20	10	10	10
Evaluate	-	10	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C913.1	3	3			3				3		2	3		
C913.2	2	2			2							2		
C913.3	2	2			3			2		2		2		
C913.4	3	3			3					2		2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME914	GAS DYNAMICS AND JET PROPULSION	3/0/0/3
Nature of Course	Theory analytical	
Pre requisites	Engineering Thermodynamics Thermal Engineering	

Course Objectives:

1	To understand the basic difference between incompressible and compressible flow.
2	To understand the phenomenon of shock waves and its effect on flow.
3	To gain basic knowledge about jet propulsion.

Course Outcomes:
Upon completion of the course, students shall have ability to

C914.1	Study the behaviour of various flow regimes.	[U]
C914.2	Assess the properties of fluid when the fluid flows under different flow conditions.	[Ap]
C914.3	Analyse the flow behaviour and consequent loads due to flow.	[A]
C914.4	Estimate propulsion efficiency and design inlets and nozzles.	[E]

Course Contents:

Compressible flow fundamentals: Energy and momentum equations for compressible fluid flows, Various regions of flow, Reference Velocities, Stagnation state, velocity of sound, Critical states, Mach Number, (Significance and Characteristics) Critical Mach number, Types of waves, Mach cone, Mach angle, Effect of Mach Number on compressibility. **Flow through variable area ducts:** Isentropic flow through variable area ducts, T-s, h-s diagrams for nozzles & diffusers, Mach number variation, Area ratio as a function of Mach number, Mass flow rate through nozzles & diffusers, Effect of friction in flow through Nozzles.

Fanno and Rayleigh flow: Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts, Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties.

Normal shock: Governing equations, variation of flow parameters like static pressure, static temperature density, stagnation pressure and entropy across the normal shock, Prandtl-Meyer Equation, Impossibility of shock in subsonic flows, Flow in convergent and divergent nozzles with shock, normal shock in Fanno and Rayleigh flows. Flow with oblique shock (Elementary treatment only).**Jet propulsion:** Aircraft propulsion, Types of Jet Engines, Energy flow through Jet Engines, Study of turbojet engine, Performance of Turbo jet engines-thrust and thrust power, propulsive and overall efficiencies.

Total Hours: 45

Text Books:

1	Yahya. S.M., “Fundamental of Compressible Flow”, New Age International (p) Ltd., New Delhi, 2015.
2	Patrich.H. Oosthvizen, William E.Carscallen, “Compressible Fluid Flow”, McGraw-Hill Education, 2013.

Reference Books:

1	Cohen. H., Rogers R.E.C and Sravanamutoo, “Gas Turbine Theory”, Addison Wesley Ltd., 2014.
2	Ganesan. V., “Gas Turbines”, McGraw-Hill Education, New Delhi, 2015.
3	Balachandran.P, “Fundamentals of Compressible Fluid Dynamics”, Prentice Hall of India, New Delhi, 2015.

Web References:	
1	http://www.grc.nasa.gov/WWW/K-12/airplane/bgp.html
2	https://ocw.mit.edu/search/ocwsearch.htm?q=gas%20dynamics
Online Resources:	
1	https://nptel.ac.in/courses/112106166/
2	http://history.nasa.gov/SP-4219/Contents.html

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C914.1	Understand	Quiz	5
C914.2	Apply	Group Assignment	5
C914.3	Analyze	Case Study	5
C914.4	Evaluate	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	10	10
Understand	30	20	10	10
Apply	30	40	40	40
Analyse	30	30	30	30
Evaluate	-	-	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C914.1	2			1								3		
C914.2	3	3	2		3							2		
C914.3	3	3	2	1								2		
C914.4	3	3	3		3						3	2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME915	POWER PLANT ENGINEERING	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Engineering Thermodynamics Thermal Engineering	

Course Objectives:

1	To provide a general perspective of power plant engineering indicating the role of mechanical engineers in their operation and maintenance.
2	To understand the construction, working principles and advantages of a combined gas turbine, steam turbine power plant and diesel power plant.
3	To create awareness about cost of electric energy, tariff calculation and economics of various power plants.

Course Outcomes:

Upon completion of the course, students shall have ability to

C915.1	Recall the various techniques used for power generation.	[R]
C915.2	Describe the functioning of components in steam power plant.	[U]
C915.3	Sketch the design layout and explain the working of diesel, gas turbine, hydroelectric, nuclear and renewable power plants.	[Ap]
C915.4	Analyze the economic feasibility and its implications on power generating units.	[A]

Course Contents:

Layout of modern coal power thermal power plant, Steam Boilers– High Pressure and Super Critical Boilers– Fluidized Bed Boilers, Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, water treatment methods, evacuation systems , De-aerators, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers. Pollution control technologies for coal plant.

Layout of Diesel power plant - Components, Selection of Engine type, layout of gas turbine power plant - Applications -Fuels - Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling (Descriptive only) – Combined Cycle. **Nuclear Energy** – Fission, Fusion Reaction, Boiling water reactor-Pressurized water reactor-Pressurized Heavy Water Reactor-Gas cooled reactor-High temperature gas cooled reactor-Pebble bed reactor-Fast breeder reactor-Liquid metal fast breeder reactor-reactor materials-Radiation shielding ,Waste Disposal and safety. **Hydel Power Plant** – Typical layout, Essential Elements, Selection of Turbines, Governing of Turbines.

Power plant using renewable/unconventional energy- Construction and working of wind, tidal, solar photo voltaic, geothermal, biogas and ocean Thermal Energy Conversion power plants, Economics of power plant – Actual load curves**,** cost of electric energy-fixed and operating Costs-energy rates – Types of Tariffs – Energy management and Energy audit, Economics of load sharing – variable load operation –Comparison of economics of various power plants.

Total Hours:	**45**

Text Books:

1	P.K. Nag, “Power Plant Engineering”, McGraw – Hill Education, Third Edition, 2014.
2	Frederick T. Morse, “Power Plant Engineering”, Affiliated East-West-Press Private Ltd.,New Delhi 2015.

Reference Books:

1	G. R. Nagpal, “Power Plant Engineering”, Khanna Publishers, New Delhi, 2015.
2	Arora S C and Domkundwar, S., “Power Plant Engineering”, DhanpatRai& Sons,20016
3	Wakil, M.M., “Power Plant Technology”, McGraw-Hill Education, 2014

Web References:	
1	www.academia.edu
Online Resources:	
1	https://nptel.ac.in/courses/112107216/
2	https://nptel.ac.in/courses/108105058/8

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C915.1	Remember	Quiz	5
C915.2	Understand	Group Discussion/ Assignment	5
C915.3	Apply	Assignment	5
C915.4	Analyze	Case study	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	40	40	40
Understand	30	30	30	30
Apply	20	20	20	20
Analyze	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C915.1	3	3			3				3		2	3		
C915.2	3	2			3			2	3		2	2		
C915.3	3	3	3		2			2	2		2	2		
C915.4	3				3			2	1			2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME916	SOLAR AND WIND ENERGY	3/0/0/3
Nature of Course	Theory Application	
Pre requisites	Nil	

Course Objectives:

1	To understand the importance of solar radiation and its utilization for the thermal needs.
2	To familiarize the student with concepts of solar and wind energy conversion
3	To provide knowledge about the various systems involved in solar and wind energy

Course Outcomes:

Upon completion of the course, students shall have ability to

C916.1	Define the basic concept of solar power generation and selection of solar panel.	[R]
C916.2	Describe the use of solar energy and the components used in the energy production applications.	[U]
C916.3	Explore the various aspects of solar thermal systems and PV cell.	[Ap]
C916.4	Analyze the characteristics of various wind turbines and wind energy conversation systems.	[A]

Course Contents:

SOLAR RADIATION: Availability, Measurement and Estimation, Isotropic and an isotropic models, Introduction to solar collectors, flat plate collectors, evacuated tube collectors, Air heater and Concentrating collectors and Thermal storage, Steady state transient analysis, Solar Pond Solar Refrigeration. Economic analysis, **MODELLING OF SOLAR THERMAL SYSTEMS AND SIMULATIONS IN PROCESS DESIGN:** Design of active systems by f-chart and utilizability methods, water heating systems, Active and passive, Passive heating and cooling of buildings, Solar distillation, Solar Drying, Solar Energy for industrial process heat, Solar thermo-mechanical power.

PHOTOVOLTAIC SOLAR CELL: P-N Junction, Metal, Schottky junction, Electrolyte, Semiconductor Junction, Types of solar cell, their Applications, Experimental Techniques to etermine the characteristics of Solar cells Photovoltaic Hybrid Systems Photovoltaic Thermal Systems, Storage Battery, Solar Array Characteristics, Evaluation, Solar Chargeable Battery.
WIND TURBINE: Structure, Statistics, Measurements and Data Presentation, Wind Turbine Aerodynamics, Momentum Theories, Basics Aerodynamics, Airfoils Characteristics, HAWT, Blade Element Theory, Prandt'ls Lifting Line Theory (prescribed wake analysis), VAWT Aerodynamic Loads in Steady Operation, Wind Turbulence, Yawed Operation and Tower Shadow.

WIND ENERGY CONVERSION SYSTEM (WECS): Sitting, Rotor Selection, Annual Energy Output, Horizontal Axis Wind Turbine (HAWT) Vertical Axis Wind Turbine, Rotor Design Considerations, Number of Blades, Blade Profile, 2/3 Blades and Teetering, Coning, Upwind/ Downwind, Power Regulation, Yaw system, Tower, Synchronous and Asynchronous Generators and Loads, Integration of Wind Energy Converters to Electrical Networks, Inverters, Testing of WECS, WECS Control System Requirements and Strategies, Miscellaneous Topics, Noise, Other Applications.

Total Hours:	**45**

Text Books:	
1	J.F.Krider and F.Kreith, “Solar Energy Handbook”, McGraw-Hill, 2016.
2	S.P.Sukhatme, “Solar Energy : Principles of Thermal Collection and Storage”, Tata McGraw -Hill, 2016.
3	F.A.Duffie and W.A.Beckman, “Solar Engineering of Thermal Processes”, John Wiley, 2015.
Reference Books:	
1	D.A.Spera, “Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering”, ASME Press, 2009.
2	L.L.Freis, “Wind Energy Conversion Systems”, Prentice Hall, 2000.
Web References:	
1	http://www.ises.ors
2	http://www.windpower-monthly.com
3	http://www.solarpv.com

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C916.1	Remember	Quiz	5
C916.2	Understand	Assignment	5
C916.3	Apply	Group Assignment	5
C916.4	Analyze	Presentation / Case Study	5

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	30
Understand	30	30	30	20
Apply	30	30	30	30
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C916.1	3				2			2	3			3		
C916.2	3		2	2					3	3		2		
C916.3	3	2		3					2			2		
C916.4	3				3			2		3	2	2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME917	INTERNAL COMBUSTION ENGINES	3/0/0/3
Nature of Course	Theory Application	
Pre requisites	Engineering Thermodynamics, Thermal Engineering	
Course Objectives:		
1	To understand the working of different IC engines and components.	
2	To impart knowledge on pollutant formation, pollution control and alternate fuels.	
3	To create awareness about recent developments in IC engines.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C917.1	Recall the concepts of combustion in IC engines	[R]
C917.2	Elaborate the working principles of spark ignition and compression ignition engines	[U]
C917.3	Explore the formation of exhaust gas components	[Ap]
C917.4	Analyse the characteristics of various emission control methods	[A]
C917.5	Discover the advances in IC engines	[Ap]

Course Contents:

SPARK IGNITION ENGINES: Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion– Combustion chambers- Air fuel ratio- Design of carburettor- Derivation of fuel jet size and venture size - **COMPRESSION IGNITION ENGINES:** Diesel Fuel Injection Systems - Stages of combustion –Direct and Indirect injection systems – Combustion chambers – Fuel spray behaviour - Spray structure and spray penetration – Air motion - Introduction to Turbo charging.

POLLUTANT FORMATION AND CONTROL: Pollutant – Sources – Formation of Carbon Monoxide, Un-burnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement - Emission norms (Bharat stage VI) and Driving cycles.

RECENT TRENDS: Air assisted Combustion - Premixed charge compression ignition engines, Homogeneous charge compression ignition engines – Lean burn engine - Stratified charge engine, Surface ignition engine, Four valve and overhead cam engines, Electronic engine management systems- Variable Geometry turbochargers – Common Rail Direct Injection Systems – Onboard Diagnostics.

	Total Hours:	**45**

Text Books:

1	John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw-Hill Education, 2018.
2	Ganesan, "Internal Combustion Engines", IV Edition, TMH, 2012.

Reference Books:

1	William B. Ribbens, Norman P. Mansour, ”Understanding Automotive Electronics”, Newnes (an imprint of Butterworth-Heinemann Ltd); 8th Revised edition edition, 2017.
2	James E. Duffy, Howard Bud Smith,”Auto Fuel and Emission Control Systems Technology”, Goodheart-Willcox, 2011.
3	Mathur. R. B. and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons, 2010.

Web References:

1	http://nptel.ac.in/courses/112103019/Cryogenic engineering.
2	http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C917.1	Remember	Quiz	5
C917.2	Understand	Assignment	5
C917.3	Apply	Group Assignment	5
C917.5			
C917.4	Analyze	Presentation / Case study	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	40	40	40	40
Understand	40	30	30	30
Apply	10	20	20	20
Analyze	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C917.1	3				2			2	3			3		
C917.2	3		2	2					3			1		
C917.3	3	2		3					2			2		
C917.4	3				3			2			2	2		
C917.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME918	CRYOGENIC ENGINEERING	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Engineering Thermodynamics Thermal Engineering	

Course Objectives:

1	To make the students understand the properties of cryogenic fluids, various liquefaction cycles, liquefaction systems and components in liquefaction system.
2	To make them understand the effect of rectification, absorption systems for purification, binary mixtures, T-C and H-C diagrams
3	To make the students understand the types of cryogenic refrigerators, various methods of handling cryogens and its applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C918.1	Define the basic concepts of cryogenic and liquefaction cycles.	[R]
C918.2	Elaborate the working principles of rectification, purification and liquefaction.	[U]
C918.3	Explore the various types of cryogenic refrigerator and understand its working procedure.	[Ap]
C918.4	Analyse the characteristics of various cryogens and explain their applications.	[A]

Course Contents:

INTRODUCTION : Insight on Cryogenics, Methods of producing cold - thermodynamic basis, first and second law analyses, Vapour compression systems, Properties of Cryogenic fluids, and Material properties at Cryogenic temperatures. **LIQUEFACTION CYCLES:** Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles, Inversion Curve-JouleThomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle, Dual Cycle, Helium Regrigerated Hydrogen Liquefaction Systems. Critical components in Liquefaction Systems.

SEPARATION OF CRYOGENIC GASES: Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis – McCabe Thiele Method. Adsorption Systems for purification. **CRYOGENIC REFRIGERATORS:** J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators.

HANDLING OF CRYOGENS AND APPLICATIONS: Cryogenic Dewar Construction and Design, Cryogenic Transfer Lines. Insulations used in Cryogenic Systems, Different Types of Vacuum Pumps, Instrumentation to measure Flow, Level and Temperature. Applications of Cryogenics in Space Programmes, Superconductivity, Cryo Metallurgy, Medical applications.

Total Hours	45

Text Books:

1	Klaus D.Timmerhaus and Thomas M.Flynn, “Cryogenic Process Engineering”, Springer US, 2013.
2	Thomas M.Flynn, “Cryogenic Engineering”, Marcel Dekker, New York, 2005,

Reference Books:

1	Mukhopadhyay, Mamata, “Fundamentals of Cryogenic Engineering”, Prentice Hall India Learning Private Limited, 2010.
2	G.Venkatarathnam, “Cryogenic Mixed Refrigerant Processes”, Springer Publication, 2010.
3	Randall F.Barron, “Cryogenic Systems”, McGraw Hill, 2002.
4	Robert W. Vance, “Cryogenic Technology”, John wiley & Sons, Inc.2002, New York.

Web References:	
1	http://www.wiley-vch.de/contents/ullmann/ull_10211.html.
2	http://www.onecro.com
3	http://www.caddet-ee.org/search/produce.cfm?ID=R072
4	http://www.sumkasons.20m.com/In2.html
5	http://www.thtcryogenics.freeserve.co.uk/crogenics.html

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C918.1	Remember	Presentation/Quiz	5
C918.2	Understand	Assignment	5
C918.3	Apply	Group Assignment	5
C918.4	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	40	30	30
Understand	40	40	40	40
Apply	10	10	20	20
Analyze	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C918.1	3	3			3				3		2	3		
C918.2	2	2			2							2		
C918.3	2	2			3			2		2		2		
C918.4	3	3			3					2		3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME919	COMPOSITE MATERIALS, PROCESSING AND APPLICATIONS	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Metallurgy and Materials Testing	

Course Objectives:

1	Introduce the concepts of modern composite materials and equip the students with knowledge on fabrication and testing of composites.
2	To make them understand the different types of composite materials, their properties and applications.
3	Describe the fundamental fabrication processes for polymer matrix, metal matrix and ceramic matrix composites.

Course Outcomes:
Upon completion of the course, students shall have ability to

C919.1	Recall the types of composite materials and their characteristic features.	[R]
C919.2	Identify the advances in composite materials and their applications.	[U]
C919.3	Apply the suitable technique for manufacturing different types of composite materials.	[Ap]
C919.4	Analyse the properties of composite materials for automotive, aerospace and industrial applications.	[A]

Course Contents:

Polymer matrix composites: Understand the concepts of Polymer matrix resins-thermosetting, thermoplastic-various types of reinforcements used in PMC, merits, demerits and applications of PMC. **PMC manufacturing processes**: Hand layup processes, Spray up processes, Bag moulding, Compression moulding, Reinforced reaction injection moulding, Resin transfer moulding. Pultrusion, Filament winding.

Metal matrix composites: Understand the concepts of MMC, Types of Metal matrix composites, Types of reinforcements used in MMC, Volume fraction, Rule of mixtures, Influence of interface bonding between matrix and reinforcement on mechanical properties of composite, coating on reinforcements, merits, demerits and applications of MMC. **Processing of MMC** – Powder metallurgy process - diffusion bonding, stir casting – squeeze casting, friction stir processing, Testing of composites as per ASTM standard, Inspection of components using ultrasonic flaw detector.

Ceramic matrix composites: Understand the concepts of Engineering ceramic materials, Ceramic matrix composites, and various types of Ceramic Matrix composites, merits, demerits and applications of CMC. **Processing of CMC**: Sintering - Hot pressing, Cold isostatic pressing (CIP), Hot isostatic pressing, **Advances in Composites:** Carbon-Carbon Composites: Understand the concepts of Carbon-carbon composites, merits, demerits and applications of CCC. Processing of Carbon composites: chemical vapour deposition, Sol-gel technique, 3D printing of composites.

Total Hours:	**45**

Text Books:

1	Ronald, F. Gibson, “Principles of Composite Material Mechanics”, Fourth Edition, CRC Press, 2016.
2	Daniel Gay “Composite Materials: Design and Applications”, Third Edition, CRC Press, 2014.

Reference Books:

1	Deborah D.L. Chung, “Composite Materials”, Second Edition, Springer, 2014.
2	Nikhilesh Chawla, Krishan K. Chawla, “Metal Matrix Composites”, Second Edition, Springer, 2013.
3	Chawla K.K., “Composite Materials”, Springer – Verlag, 2012.

Web References:	
1	https://www.youtube.com/watch?v=VMH6qbED7pg
2	https://www.youtube.com/watch?v=LHHAPJbakEc
Online Resources:	
1	https://nptel.ac.in/courses/112104168/
2	https://nptel.ac.in/courses/101104010/1

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C919.1	Remember	Quiz	5
C919.2	Understand	Technical Presentation	5
C919.3 C919.4	Apply Analyse	Assignment	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	50	20	20
Understand	30	30	30	30
Apply	20	20	30	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C919.1	3											1	2	
C919.2	3											2	1	
C919.3	3	3	3									2	3	
C919.4	3	3	3										3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME920	INDUSTRIAL LAYOUT, ERGONOMICS AND SAFETY ENGINEERING	3/0/0/3
Nature of Course	Theory application	
Pre requisites	Manufacturing Technology I & II	

Course Objectives:	
1	To acquire knowledge about industrial layout.
2	To promote the safety culture and its importance in industry.
3	To enable the students to identify the causes of accidents and the impact of accident costs.
4	To impart knowledge on OSHAS (Occupational Safety and Health Assessment Series) in jobsite safety.
5	To enable students to implement the hazard and risk assessment techniques.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C920.1	Identify the key factors for location decision and site selection.	[R]
C920.2	Understand plant layout for betterment of the layout design.	[U]
C920.3	Summarise the OSHA's general reporting and record keeping rules and guidelines.	[U]
C920.4	Implement the ergonomic aspects in product design.	[Ap]
C920.5	Demonstrate the ability to avoid, prevent and control workplace hazards.	[A]

Course Contents:

Plant Layout: Plant location and site selection, Importance of Plant Location, Dynamic Nature of Plant Location, Facilities Design Procedure, Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors and process plant, Evaluation and Improvement of Layout, Quantitative methods of Plant layout: CRAFT and CORELAP, Relationship diagrams.

Hazards: Electrical hazards, detection and prevention of electrical hazards, Chemical hazardous materials, material safety Material Safety Data Sheet (MSDS Fire hazard and life safety) Mechanical hazards and machine safe guarding common mechanical hazards, safeguarding and OSHA's requirement for safeguarding Industrial safety awareness Safety health and the environment Hazards of the environment Hazardous waste reduction Cost of accident and accident preventions Workman's compensation issues. Hazard analysis, prevention and safety management, Tactile and non-tactile methods

Safety and Health : Safety and health training, Occupational Safety and Health Administration, OSHA Worker's Rights, Employer Responsibilities Occupational safety and work place violence. **Ergonomics:** Interdisciplinary nature of ergonomics, Ergonomic considerations including repetitive motion, Stress and safety, Osha's voluntary Ergonomics guidelines, Economics of Ergonomics considerations in workplace lightings, workstation design, welfare facilities, plant layout and machine design**.**

Total Hours:	**45**

Text Books:

1	Theresa Stack, Lee T. Ostrom, Cheryl A. Wilhelmsen "Occupational Ergonomics: A Practical Approach", John Wiley & Sons, 2016.
2	Mark A. Friend, James P. Kohn "Fundamentals of Occupational Safety and Health", 6th edition by Government Institutes Inc., 2014.

Reference Books:	
1	Charles D. Reese “Occupational Health and Safety Management: A Practical Approach”, Third edition, CRC Press 2015.
2	Gavriel Salvendy, “Handbook of Human Factors and Ergonomics”, Fourth edition, John Wiley & Sons 2012.
Web References:	
1	https://alison.com/courses/Workstation-Ergonomics
2	http://ergonomics.org/
Online Resources:	
1	http://nptel.ac.in/courses/107103004/31
2	http://dce.mst.edu/credit/certificates/safetyengineering/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C920.1	Remember	Quiz	5
C920.2	Understand	Technical Presentation/ Group Discussion	10
C920.3	Understand		
C920.4	Apply	Poster presentation	5
C920.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	40	20	20
Understand	40	40	30	30
Apply	20	20	30	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C920.1	3	3	3		3		3		3	2		1	3	
C920.2	3	3	2		3		3		3	2		2		
C920.3	3	3	3		3		3		3	2		1	3	
C920.4	3	3	3		3		3		3	2		1	3	
C920.5	3	2	2		2		2		3	2		1		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME921	ADDITIVE MANUFACTURING	3/0/0/3
Nature of Course	Theory Application	
Pre requisites	Manufacturing Technology II	

Course Objectives:

1.	To develop skills, ideas and knowledge about additive manufacturing process.
2.	To demonstrate about liquid, solid and powder based additive manufacturing process.
3.	To impart knowledge about additive manufacturing data formats and its applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C921.1	Understand the basics of additive manufacturing process	[U]
C921.2	Apply the various types of additive manufacturing and tooling techniques.	[Ap]
C921.3	Understand the basics of reverse engineering process	[U]
C921.4	Analyze the additive manufacturing data formats.	[A]

Course Contents:

Introduction to Rapid Manufacturing: History of AM systems, Fundamentals of Prototyping and Rapid Prototyping, Classification of AM process, Rapid Prototyping Process Chain, Reverse Engineering – Basic concepts, Digitization Techniques – Model Reconstruction – Design for AM – Survey of AM applications, growth of AM industry. **Data Processing for Rapid Manufacturing:** Conceptualization and CAD model preparation, data formats – Conversion to STL file format, Fixing the STL file, Part orientation, Support structure design, Model Slicing, Direct and adaptive slicing, Tool path generation, AM Software's.

Liquid Based Additive Manufacturing Systems: Stereo lithography Apparatus, Solid Ground Curing - Polyjet - Principle of operation, Machine details, Materials, Process details, Process parameters, Data preparation and Applications, Advantages and Disadvantages, Case studies. **Solid Based Additive Manufacturing Systems:** Laminated Object Manufacturing and Fused Deposition Modeling - Principle of operation, Machine details, Materials, Process details, Process parameters, Data preparation and Applications, Advantages and Disadvantages, Case studies. **Powder Based Additive Manufacturing Systems:** Selective laser sintering, Electron Beam Melting and Laser Engineered Net Shaping - Principle of operation, Machine details, Materials, Process details, Process parameters, Data preparation and Applications, Advantages and Disadvantages, Case studies.

Post-Processing: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques. **Rapid Tooling:** Introduction, Indirect rapid tooling - silicone rubber tooling, Reaction Injection Molding, Wax Injection Molding, vacuum casting, aluminum filled epoxy tooling, spray metal tooling- Direct rapid tooling - quick cast process, rapid tool, copper polyamide, prometal, wire and arc additive manufacturing, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.

Total Hours:	**45**

Text Books:

1	Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
2	Rafiq Noorani, "Rapid Prototyping - Principles and Applications", John Wiley & Sons, Inc., 2006.

Reference Books:	
1	Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2011.
2	Andreas Gebhardt, — Rapid Prototypingll, Hanser Gardner Publications Inc., 2003.
Web References:	
1	https://www.youtube.com/watch?v=NkC8TNts4B4
Online Resources:	
1	http://nptel.ac.in/courses/112107077/382.
2	http://nptel.ac.in/courses/112107078/37
3	http://nptel.ac.in/courses/112102103/16

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C921.1	Understand	Industrial Case Study/ Project and Conference/ Journal Publications	20
C921.2	Apply		
C921.3	Understand		
C921.4	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	20	20
Understand	40	40	30	30
Apply	30	30	30	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C921.1	3	2	2										3	
C921.2	3	2	2								2		2	2
C921.3	3	2	2				2				2		3	
C921.4	3	2	2				2				2		3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME922	LEAN SIX SIGMA AND AGILE MANUFACTURING	3/0/0/3
Nature of Course	Theory Application	
Pre requisites	Manufacturing Technology – I & II	

Course Objectives:

1	To impart the knowledge to deliver consistently high quality and value-added products and services to the customers.
2	To enable the students to understand the general guidelines for implementation of lean six sigma.
3	To make the students implement lean six sigma tools to minimize the cost/time and maximize quality.
4	To enable the students to understand various terms related to agile manufacturing.
5	To execute various phases of lean six sigma and agile methodology for real time projects

Course Outcomes:

Upon completion of the course, students shall have ability to

C922.1	Recall the various applications of lean six sigma and agile manufacturing tools in industries.	[R]
C922.2	Understand the implementation of lean six sigma and agile manufacturing concepts in the industries.	[U]
C922.3	Apply the various principles of agile manufacturing.	[Ap]
C922.4	Reduce the process variation and improve the efficiency of the process using various tools of lean six sigma	[A]
C922.5	Evaluate the various industrial projects and improve the performance.	[E]

Course Contents:

INTRODUCTION TO LEAN SIX SIGMA: Objectives of lean manufacturing-key principles and implications of lean manufacturing- Traditional vs Lean manufacturing. Value creation and waste elimination- Types of wastes –Push and Pull production - Continuous flow- Worker involvement -Cellular layout- Lean Six sigma defined – six sigma compared to total quality management – transactional vs. Manufacturing six sigma – common terms. Lean Six Sigma training plan, project selection, assessing organizational readiness, and pitfalls.

LEAN SIX SIGMA PHASES: Define & Measure Phases**-** Project charter – Voice of the customer, business – High level process map –project team – data collection – choosing statistical software .Measure tools – process maps, pareto charts, cause and effect diagrams, histograms, control charts – six sigma measurements – cost of poor quality – measurement system analysis – process capability calculations - Quality Function Deployment (QFD). Analyse Phase - Process analysis – Survival analysis, Failure Modes and Effects Analysis (FMEA), Design of Experiments (DOE). Improve And Control Phases– process redesign – generating improvement alternatives — pilot experiments – cost/benefit analysis – Implementation plan.–Control plan – Process scorecard - SPC charts, Final project report and documentation,Case studies.

THE AGILE PRODUCTION SYSTEM: The task aligned organisation - Agile manufacturing production system –The Agile wheel, Agile Business Models - production, production support, production planning and control, quality assurance, purchasing, maintenance. Agile Project Management., Agile manufacturing practices for product development.

Total Hours:	**45**

Text Books:

1	Betsiharris Ehrlich, “Transactional Six Sigma and Lean Servicing”, St. Lucia Press, 2015.

2	Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India (PHI) Private Limited, New Delhi, India, 2012.
Reference Books:	
1	Jay Arthur, “Lean Six Sigma – Demystified”, Tata McGraw Hill Companies Inc, 2014.
2	Michael L George, David T Rowlands, and Bill Kastle, “What is Lean Six Sigma”, McGraw Hill, New York, 2014.
3	Gunasekaran A, "Agile Manufacturing, 21st Strategy Competitiveness Strategy", Elsevier Publications, 2015.
4	Jay Arthur, “Lean Six Sigma – Demystified”, Tata McGraw Hill Companies Inc, 2014.
Web References:	
1	https://ocw.mit.edu/courses
2	https://www.tutorialspoint.com/six_sigma/six_sigma_introduction.htm
Online Resources:	
1	http://nptel.ac.in/courses/110105039/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C922.1	Remember	Objective type Quiz	4
C922.2	Understand	Assignment	4
C922.3	Apply	Assignment	4
C922.4	Analyze	Tutorial	8
C922.5	Evaluate		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	30	30
Understand	40	40	20	30
Apply	20	20	30	20
Analyze	10	10	10	10
Evaluate	-	-	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C922.1	3	3			3				2		3			3
C922.2	3	3			3			2	2		2		2	
C922.3	3	3	2		3			2	3		2		2	3
C922.4	3				3			2	1					2
C922.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME923	THEORY OF METAL CUTTING	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Manufacturing Technology I, Manufacturing Technology II	

Course Objectives:

1	To familiarize the student with tool nomenclature and cutting forces.
2	To provide knowledge about heat distribution and thermal aspects of machining.
3	To impart knowledge on tool materials, tool life and tool wear.
4	To educate the students on machining dynamics and economics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C923.1	Enumerate tool materials, tool life and tool wear.	[R]
C923.2	Analyze the cutting forces in turning, drilling and milling operations.	[A]
C923.3	Identify tool information and thermal aspects of various machining process.	[Ap]
C923.4	Understand the machine dynamics and the economics of machining.	[U]

Course Contents:

Introduction: Classification of machine tools – Principle of machining- Basic mechanism of chip formation - types of Chips-Chip breaker - Orthogonal Vs Oblique cutting - force and velocity relationship and expression for shear plane angle in orthogonal cutting –.Tool Nomenclature and Cutting Forces: Nomenclature of single point tool - Systems of tool Nomenclature - Nomenclature of multi point tools like drills, milling cutters and broaches. - Modern theories in Mechanics of cutting - Merchant and Lee Shaffer Theories- Forces in drilling and milling - specific cutting pressure and energy.

Thermal Aspects of Machining: Thermodynamics of chip formation - Heat distributions in machining - Effects of various machining parameters on temperature - Method of temperature measurement in machining – Hot machining –Cutting fluids. Tool Materials, Tool Life and Tool Wear: Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders -Tool life - Conventional and accelerated tool life tests – tool wear and wear mechanisms - Concepts of machinability and machinability index.

Machining Dynamics: Types of machine tool vibration – forced vibration – self exited vibrations (Chatter) – types of chatters - Chatter prediction – vibration control – Machining economics and optimizations: Manufacturing cost – relationship between machining cost, production rate and cutting speed - Economic considerations – role of computerized optimization system – Computer Aided Process Planning – basic factor involved in optimization of machining system – case study of optimization of single pass operation.

Total Hours:	**45**

Text Books:

1	WitGrzesik, “Advanced Machining Processes of Metallic Materials”, 2nd Edition, Elsevier,2016.
2	Shaw .M.C., “Metal cutting Principles ", Oxford Clarendon Press, 2nd Edition, 2005.
3	Juneja. B. L and Sekhon.G.S, "Fundamentals of Metal Cutting and Machine Tools", New Age International (P) Ltd., 2005.

Reference Books:

1	Stephenson, David A and Agapiou, John S, “Metal Cutting Theory and Practice (Manufacturing Engineering and Materials Processing)”. CRC Press, 2016
2	Bhattacharya, "Metal Cutting Theory and Practice ", New Central Book Agency, 2010.
3	Geoffrey Boothroyd and Knight. W.A "Fundamentals of Machining and Machine Tools", CRC Press, New York, 2006.

Online Resources:	
1	https://nptel.ac.in/downloads/112105127/
2	https://nptel.ac.in/courses/112104195/43

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C923.1	Remember	Quiz	5
C923.2	Analyze	Case study/Tutorial	10
C923.3	Apply	Assignment	5
C923.4	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	30	20	20
Understand	40	30	30	40
Apply	10	40	30	20
Analyze	30	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C923.1	3	2	2		3								2	
C923.2	3	3	3		3								2	
C923.3	3	3	3		3			2					2	
C923.4	3	3	3		3			3						2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME924	ENTREPRENEURSHIP DEVELOPMENT AND MANAGERIAL SKILLS	3/0/0/3
Nature of Course	Theory Skill based	
Pre Requisites	Nil	

Course Objectives:

1	To make the students understand the scope of entrepreneurship and key areas of development.
2	To enable the students to identify the financial assistance offered by the institutions, methods of taxation and tax benefits.
3	To enable the students to understand the government policies for establishing small scale business entities.

Course Outcomes:

Upon completion of the course, students shall have ability to

C924.1	Define the basic concepts of entrepreneurship and skills needed for entrepreneurial management.	[R]
C924.2	Identify the motivational factors and techniques for evaluating business opportunities	[U]
C924.3	Identify the opportunities for launching start-ups and expansion	[Ap]
C924.4	Apply accounting and financing skills to make sound business decisions and overcome risks.	[Ap]
C924.5	Analyze the performance of a new venture	[A]

Course Contents:

Entrepreneurship: Entrepreneur, Types of Entrepreneurs, Difference between Entrepreneur and Intrapreneur, Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth, Knowledge and Skills of Entrepreneur. **Motivation:** Major Motives Influencing an Entrepreneur, Achievement Motivation Training, Self-Rating, Stress management, Entrepreneurship Development Programs, Need, Objectives.

Business: Small Enterprises, Definition, Classification, Characteristics, Ownership Structures, Project Formulation, Steps involved in setting up a Business, Identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment, Preparation of Preliminary Project Reports, Project Appraisal, Sources of Information, Classification of Needs and Agencies, Business plan preparation, MSME Schemes. **Overview of Intellectual Property:** Introduction and need for intellectual property rights.

Financing And Accounting: Need, Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Balance sheet, Break Even Analysis, Network Analysis Techniques of PERT/CPM, Taxation, Income Tax, Excise Duty, Sales Tax, GST-An Introduction. **Support To Entrepreneurs:** Sickness in small Business, Concept, Magnitude, causes and consequences, Corrective Measures, Business Incubators, Government Policy for Small Scale Enterprises, Growth Strategies in small industry, Expansion, Diversification, Joint Venture, Merger and Sub Contracting, Entrepreneurship Development Support, Central and State Government Industrial Policies, Government clearance and liberalization.

Total Hours:	**45**

Text Books:

1	Hisrich R D and Peters M P, “Entrepreneurship”, 10th Edition, Mc Graw-Hill, 2016.
2	Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning, 2014.

Reference Books:	
1	S.S.Khanka “Entrepreneurial Development” S.Chand & Co. Ltd., 4th Edition, 2013.
2	Nuzhath Khatoon, “Entrepreneurial Development”, Himalaya Publishing House Pvt. Ltd, 2012.
Web References:	
1	https://www.shopify.in/encyclopedia/entrepreneurship
Online Courses:	
1	http://nptel.ac.in/courses/118105009/50
2	https://www.coursera.org/specializations/wharton-entrepreneurship

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C924.1	Remember	Quiz	4
C924.2	Understand	Class Presentation/ Assignment	4
C924.3 C924.4	Apply	Group Assignment	**4**
C924.5	Analyze	Case Study	**8**

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	40	30	30
Understand	60	40	30	30
Apply	-	20	20	20
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C924.1	3	3			3	3			2		3		1	
C924.2	3	3			3	3		2	2		2		1	
C924.3	3	3	3		3	3		2	3		2		1	
C924.4	3				3	3		2	1					
C924.5	3	3	3		3	3		2		2	2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME925	MODERN MANUFACTURING PROCESSES	3/0/0/3
Nature of Course	Theory	
Pre Requisites	Manufacturing Technology II (with lab)	

Course Objectives:

1	To understand the unconventional manufacturing processes and study its advantages over conventional techniques.
2	To impart knowledge about the tools, accessories and processes used in various unconventional manufacturing.
3	To understand the applications of various unconventional manufacturing process.

Course Outcomes:
Upon completion of the course, students shall have ability to

C925.1	Recall the importance of unconventional machining processes and its techniques	[R]
C925.2	Understand the principle and applications of mechanical and electrical energy based processes	[U]
C925.3	Choose the etchants, maskant, techniques of applying maskants for chemical and electro chemical machining processes	[Ap]
C925.4	Analyze the principle and applications of thermal energy based processes, unconventional welding and forming process.	[A]

Course Contents:

Introduction: Unconventional machining Process, Need, classification. **Mechanical Energy and Electrical Energy Based Processes:** Abrasive Jet Machining, Water Jet Machining, Abrasive Water jet Machining, Abrasive flow Machining, Magnetic Abrasive Finishing, Ultrasonic Machining - Working Principles - equipment used - Process variables - Applications. Electric Discharge Machining (EDM) - working principles-equipments- Process Parameters - MRR - Tool Wear, Wire cut EDM – Applications.

Chemical and Electro-Chemical Energy Based Processes- Chemical machining and Electro-Chemical machining (CHM and ECM) – Principles – equipments – MRR - Electrical circuit - Process Parameters, Etchants, maskant, techniques of applying maskants, ECG and ECH - Process Parameters – MRR - Applications.

THERMAL ENERGY BASED PROCESSES - Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Principles – Equipment – Types - Beam control techniques – Applications. **Unconventional welding processes**: Explosive welding, Cladding, Under water welding, Metalizing, Plasma arc welding/cutting. **UNCONVENTIONAL FORMING PROCESSES -** Principle, working and applications of High energy forming processes like Electromagnetic forming, water hammer forming, explosive compaction.

Total Hours: 45

Text Books:

1	P.C Pandey And H.S. Shan, “Modern Machining Process”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2017.
2	V.K. Jain, “Advanced Machining Process”, Allied Publishers Pvt Limited, 2007.

Reference Books:

1	Mikell P. Groover,Principles of Modern Manufacturing, SI Version Fifth Edition, Wiley & sons Pvt. Ltd, 2014.

Web References:

1	http://www.engr.iupui.edu/departments/me/courses/me/49700Modern%20Manufacturing%20Processes.php

Online Resources:

1	http://nptel.ac.in/courses/112104028/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C925.1	Remember	Quiz	5
C925.2	Understand	Assignment	5
C925.3, C925.4	Apply, Analyze	Case study	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	40	30	30	30
Understand	40	40	30	30
Apply	20	30	30	30
Analyse	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C925.1	2	3	3		2			3	3	3	3		3	1
C925.2	2	3	3		2			3	3	3	3		3	2
C925.3	2	3	3		2			3	3	3	3		3	2
C925.4	2	3	3		2			3	3	3	3		3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME926	ENGINEERING MANAGEMENT AND FINANCIAL ACCOUNTING	3/0/0/3
Nature of Course	Theory application	
Pre Requisites	Nil	

Course Objectives:

1	To impart the fundament knowledge on demand and supply analysis.
2	To make the students understand the methods of calculating production cost and fix the price of a product thereof.
3	To enable the students to understand the principles, functions and practices adapted in industry for the successful management of financial accounting.
4	To provide the fundamental knowledge on capital budgeting to evaluate a project.

Course Outcomes:

Upon completion of the course, students shall have ability to

C926.1	Demonstrate the fundament knowledge on demand and supply analysis.	[U]
C926.2	Calculate the production cost and fix price tag for a product based on the gross expenses and market scenario.	[Ap]
C926.3	Apply the basic principles, functions and practices for managing the financial accounts.	[Ap]
C926.4	Make investment decisions based on the projected return on investments.	[A]

Course Contents:

INTRODUCTION Managerial concepts - Relationship with other disciplines - Firms: Types, objectives and goals -- Enterprise Performance Management - Managerial decisions - Decision analysis. **DEMAND & SUPPLY ANALYSIS:** Break even analysis - Demand - Supplier demand - Types of demand - Determinants of demand - Demand function - Demand elasticity -Demand forecasting - Supply - Determinants of supply - Supply function - Supply elasticity.

PRODUCTION AND COST ANALYSIS Production function - Returns to scale - Production optimization - Least cost input – Isoquants - Managerial uses of production function, Decision making-make/buy. Cost Concepts- Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost – Pricing - Determinants of Price - Pricing under different objectives and different market structures- Price discrimination - Pricing methods in practice.

FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis – Break even analysis - Cash flow analysis -Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements **CAPITAL BUDGETING (ELEMENTARY TREATMENT)** Investments - Risks and return evaluation of investment decision - Average rate of return- Payback Period - Net Present Value - Internal rate of return.

Total Hours:	**45**

Text Books:

1	C. M. Chang, “Engineering Management: Meeting the Global Challenges”, CRC Press , Second Edition, 2016.
2	B. Ram, “Accounting for Managers”, New Age Publications (Academic) Edition: First, 2015.

Reference Books:

1	A.K. Gupta, “Engineering Management”, S. Chand Publication, 2014.
2	Narayanaswamy R., “Financial Accounting: A Managerial Perspective”, PHI Learning Private Limited; 6th Revised edition, 2017.

Web References:	
1	http://bookboon.com/en/accounting-basics-ebooks
2	http://bookboon.com/en/management-organisation-ebooks
Online Resources:	
1	https://nptel.ac.in/courses/110101003/
2	https://onlinecourses.nptel.ac.in/noc16_mg02/course

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C926.1	Understand	Quiz	5
C926.2	Apply	Assignment Presentation	5
C926.3	Apply	Group Assignment	5
C926.4	Analyze	Accounting Case	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	20	20
Understand	50	40	40	40
Apply	20	30	20	20
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C926.1	2	3	2	3	3	3					1	2		
C926.2	2		2			3					2			
C926.3	2	2				3					2			
C926.4	2	2		3	2	3					2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME927	ADVANCED CASTING AND WELDING PROCESSES	3/0/0/3
Nature of Course	Theory	
Pre Requisites	Manufacturing technology I Metallurgy and Materials Testing	

Course Objectives:

1	To understand the principle of casting design.
2	To study the different type of special casting process.
3	To understand the fundamentals of welding process.
4	To validate the welded structure.

Course Outcomes:

Upon completion of the course, students shall have ability to

C927.1	Understand the casting metallurgy.	[U]
C927.2	Impart the knowledge on design parameters of casting and welding process.	[Ap]
C927.3	Understand the advancement in casting processes and welding processes	[U]
C927.4	Analyze the testing procedure to check the soundness of casting and welding products.	[A]

Course Contents:

CASTING METALLURGY AND DESIGN Heat transfer between metal and mould interface- Solidification of pure metal and Alloys-Shrinkage in cast metals -progressive and directional solidification. Principles of gating - Riser and Runner. Computer aided design and analysis of casting - Casing defects. **SPECIAL CASTING PROCESSES** Introduction to casting of metals and composites - centrifugal casting, stir casting, squeeze casting, continuous casting, vacuum mould casting, evaporative pattern casting, ceramic shell casting – Introduction to smart foundry.

WELDING METALLURGY AND DESIGN Significance, Heat affected Zone and its characteristics, Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design, computer aided design and analysis of welding – welding defects **RECENT TRENDS IN WELDING –** Hot wire GTAW, Active and keyhole TIG, Friction stir welding, diffusion bonding, high frequency induction welding, MIAB welding, cold metal transfer welding process, ultrasonic welding, electron beam welding, Laser beam welding, Plasma welding and under water welding – Robot welding.

TESTING OF CASTINGS AND WELDMENTS Preparation of casted and welded specimens as per ASTM standard – Surface modification of casting and welding, heat treatment, shot and laser peening. Characterization of Microscopy, SEM, EDOX, EBSD – Behavior of Macro and Micro hardness, Tensile strength, Impact strength, flexural strength, fatigue strength, wear and friction test. Non-Destructive test: Magnetic particle inspection - liquid penetration test – Radiographic test - ultrasonic test – Electromagnetic test – LASER testing methods – Leak test.

Total Hours:	**45**

Text Books:

1	Jain, “Principles of Foundry Technology ", Tata McGraw Hill, 3rd Edition, 2009.
2	Richard L Little, “Welding and Welding Technology” Tata McGraw Hill, 2004.

Reference Books:

1	George E Dieter. “Mechanical Metallurgy”, McGraw Hill Education (India) pvt ltd., 2013.
2	Norrish, “Advanced welding process”, Wood Head Publishing in Materials, Cambridge, UK,2006.
3	Larry Jeffus, “Welding Principles and Applications” Delmar Publishers, 2004.

4	Howard B Cary, " Modern Welding Technology" Prentice Hall, 2002.
5	John Campbell, "Casting Practice" Elsevier Science Publishing C0.,2004.
6	"ASM Hand Book Volume15: Casting", ASM International 2008.
Online Resources:	
1	https://nptel.ac.in/courses/112107077/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C927.1	Understand	Assignment / seminar	10
C927.2	Apply		
C927.3	Understand	Assignment / Case study	10
C927.4	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	40	40	40	30
Apply	40	40	20	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C927.1	3	2	3		3		3		3	3		1	2	1
C927.2	3	2	2		3		3		3	3			2	
C927.3	3	3	1		1		1		3	3		2	2	1
C927.4	3	3	3		3		3		3	3		1	3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Open electives

18ME001	INDUSTRIAL SAFETY	3/0/0/3
Nature of Course	Theory	
Pre Requisites	Nil	

Course Objectives:

1	To enable students to understand the basic Industrial safety engineering acts and rules.
2	To impart knowledge on OSHAS (Occupational Safety and Health Assessment Series) in engineering Industry.
3	To enable the students to identify the causes of accidents and its preventions.
4	To make students to identify hazard and assess the risks using suitable techniques.

Course Outcomes:
Upon completion of the course, students shall have ability to

C001.1	Identify the evolution of industrial safety acts, rules and health standards.	[R]
C002.2	Summarize different safety management activities in industry.	[U]
C003.3	Prepare accident, investigation report and preventive guidelines to industry.	[Ap]
C004.4	Analyse the process to avoid, prevent and control workplace hazards.	[A]

Course Contents:

BASICS OF SAFETY ENGINEERING & ACTS: Evolution of modern safety concept – safety audit; Acts – factories act – 1948 – statutory authorities – inspecting staff – Tamilnadu factories Rules 1950 under safety and health – environment act 1986 – air act 1981, water act 1974 – labour laws; safety in industries – general safety concepts, machine guarding, hazards in metal removing process, Introduction to OHSAS 18000 and 14000, National Disaster Management Act.

SAFETY MANAGEMENT: History of Safety movement – general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling. Fire Explosion and toxicity Index. **ACCIDENT INVESTIGATION AND REPORTING:** Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents - Class exercise with case study

SAFETY PERFORMANCE MONITORING: Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate. **SAFETY EDUCATION AND TRAINING:** Importance of training - identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

Total Hours:	**45**

Text Books:

1	Charles D. Reese "Occupational Health and Safety Management: A Practical Approach", 3rd Edition CRC press 2015.
2	Mark A. Friend, James P. Kohn "Fundamentals of Occupational Safety and Health" 6th Edition Bernan press, 2014.
3	Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay 2015

Reference Books:	
1	John V. Grimaldi, Rollin H. Simmons, “Safety Management”, Irwin publishers, 5th edition, 1989
2	R.K. Mishra,“Safety Management”, AITBS publishers, 2016
3	Relevant India Acts and Rules, Government of India, 2017
4	C. Ray Asfahl, David W. Rieske “ Industrial Safety and health management”, Practice,7th Edition, Pearson, 2018
Web References:	
1	www.nptel.ac.in/courses/110105094
Online Resources:	
1	http;//nptel.ac.in/courses/112107143/40
2	http://dce.mst.edu/credit/certificates/safety engineering

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C001.1	Remember	Quiz	4
C001.2	Understand	Assignment	4
C001.3	Apply	Technical Seminar	4
C001.4	Analyse	Case study	8

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	30	10	30
Understand	40	40	40	30
Apply	20	30	40	30
Analyse	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C001.1	2	3	2	3	3	2					1	3		
C002.2	2		2			2					2		3	
C003.3	2	2				3					2			3
C004.4	2	2		3	2	2					2		3	2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME002	MEMS/NEMS	3/0/0/3
Nature of Course	Theory	
Pre requisites	Engineering Physics and Chemistry.	

Course Objectives:

1	To make the students learn various techniques available to make micro shapes using various materials.
2	To impart the methodologies to be followed in micro fabrication and forming.
3	To enhance the students knowledge about MEMS / NEMS devices and their applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C002.1	Recall the basic concepts related to MEMS / NEMS.	[R]
C002.2	Understand the various fabrication techniques and micro machining processes for MEMS / NEMS.	[U]
C002.3	Apply various fabrication techniques to develop a MEMS / NEMS System.	[Ap]
C002.4	Analyse the characteristics of MEMS and NEMS devices.	[A]

Course Contents:

INTRODUCTION TO MEMS/NEMS: Introduction – MEMS vs NEMS - Evolution of Micro-sensors and MEMs Mechanical, Inertial, Biological, Chemical, Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS, Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS, Introduction to NEMS – Nano-mechanical Resonators, Nano-mechanical Sensors. **LITHOGRAPHY:** Introduction - Lithography's Origins, Photolithography- Overview Critical Dimension -Line-Width - Lithographic Sensitivity and Intrinsic Resist Sensitivity Resist Profiles- Contrast and Experimental Determination of Lithographic Sensitivity Resolution in Photolithography - Photolithography Resolution - Enhancement Technology Beyond Moore's Law Next Generation - Lithographies Emerging Lithography Technologies.

ADDITIVE TECHNOLOGY: Introduction –Silicon Growth -Doping of Si - Oxidation of Silicon-Physical Vapor Deposition - Chemical Vapor Deposition- Silk-Screening or Screen-Printing - Sol-Gel Deposition Technique. Plasma Spraying - Deposition and Arraying Methods of Organic Layers in BIOMEMS and BIONEMS - Thin versus Thick Film Deposition - Selection Criteria for Deposition Method. Nanofabrication with EBL & IBL.

MINIATURIZATION TECHNIQUES Introduction - Absolute and Relative Tolerance in Manufacturing - Historical Note: Human Manufacturing - Top-Down Manufacturing Methods-Surface Micromachining, Silicon on Insulator Technology (SOI), Bottom-Up Approaches - modelling, brains, packaging, sample preparation and new MEMS materials Introduction-Modelling, Brains in Miniaturization- Packaging, Substrate Choice. **MINIATURIZATION APPLICATIONS**: Introduction - Scaling, Actuators, Fluidics- Scaling in Analytical Separation Equipment- Other Actuators - Integrated Power miniaturization applications- Introduction - Definitions and Classification Method – MOEMS – Principles and Applications to Automotive, Telecom and Biomedical.

Total Hours:	**45**

Text Books:

1	Tai-Ran-Hsu, “MEMS & Microsystems: Design and Manufacture”, McGraw Hill, 17th Reprint, 2013.
2	Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2nd Edition, 2011.

Reference Books:	
1	Mahalick N P, “MEMS”, Tata McGraw Hill Education, 2008.
2	Sergey Edward Lyshevski, “Micro-Electro Mechanical and Nano-Electro Mechanical Systems, Fundamental of Nano-and Micro-Engineering”, CRC Press, 2005.
Web References:	
1	https://youtu.be/ZcCXFrHQ7Ao/Introduction to Materials Science for MEMS and NEMS
Online Resources:	
1	https://nptel.ac.in/courses/117105082/
2	https://www.coursera.org/learn/MEMS/NEMS

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C002.1	Remember	Assignment	5
C002.2	Understand	Objective type Quiz	5
C002.3	Apply	Technical Presentation	5
C002.4	Analyse	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	30	20
Understand	40	40	30	40
Apply	40	40	30	30
Analyze	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C002.1	2	2	2									1		
C002.2	2	3	3			1							3	
C002.3	2	3	3		3					1	3		3	3
C002.4	2	3	3	2	3					1	3		3	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME003	TOTAL QUALITY MANAGEMENT	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Nil	
Course Objectives:		
1	To understand the engineering and management aspects of quality planning and control.	
2	Study the methodology of improving quality in manufacturing process / products.	
3	To understand the concepts of quality management system.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C003.1	Define the basic concepts of quality management.	[R]
C003.2	Understand the fundamentals of total quality management and its tools.	[U]
C003.3	Elaborate the role of TQM tools and techniques in elimination of wastages and reduction of defects.	[Ap]
C003.4	Inculcate the concepts of quality and continuous improvement as a passion and habit.	[Ap]
Course Contents:		
QUALITY GURUS AND TQM KITEMARKS: Evolution of TQM, Quality Guru's - Edward Deming, Joseph Juran, Philip Crosby, Genichi Taguchi, Walter Shewart ,Criteria for Deming's Prize. PRODUCT DESIGN AND ANALYSIS: Basic Design Concepts and TQM, Failure Mode Effect Analysis, Fault Tree Analysis, Design for Robustness, Value Analysis. **PROCESS IMPROVEMENT AND MODERN PRODUCTION MANAGEMENT TOOLS:** Six Sigma Approach, Total Productive Maintenance, Just-In-Time, Lean Manufacturing, Paradigms QUALITY IMPROVEMENT TOOLS AND CONTINUOUS IMPROVEMENT: Q-7 Tools, New Q-7 Tools, Quality Function Deployment, Kaizen, 5S, Poka-Yoke, SMED. **QUALITY MANAGEMENT SYSTEMS:** Quality Management Systems, Introduction to ISO9000, TS16949:2002 and EMS14001 certifications. OHSAS 18001 Occupational Health & Safety Assessment Series.		
	Total Hours:	**45**
Text Books:		
1	Dale H. Bester field "Total Engineering Quality Management", , 4th Edition, , Pearson Education, 2017.	
2	Sunil Sharma "Total Engineering Quality Management", 4th Edition, MacMillan India Limited, 2016.	
Reference Books:		
1	Poornima M. Charantimath "Total Quality Management", 3nd Edition, Pearson Education, 2017.	
2	James R Evans, "Quality and Performance Excellence", Edition, 7th Edition, Cengage Learning ,2016.	
Web References:		
1	https://managementhelp.org/quality/total-quality-management.htm	
Online Resources:		
1	https://onlinecourses.nptel.ac.in/noc17_mg18/preview	
2	https://www.apnacourse.com/course/quality-management	

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C003.1	Remember	Presentation	5
C003.2	Understand	Assignment	5
C003.3 C003.4	Apply	Case study	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	40	40	40	40
Understand	50	50	40	40
Apply	10	10	20	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C003.1	3	3			3	3								
C003.2	3	2			1	3							1	
C003.3	3	3			3	3		2		1				1
C003.4	3	2			2	3		2		1			1	1

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME004	PRODUCT DEVELOPMENT	3/0/0/3
Nature of Course	Theory application	
Pre Requisites	Nil	

Course Objectives:

1	To understand the basic concept of product development.
2	To learn the concepts and tools that necessary for product design manufacturing
3	To apply the new product development process by devising a new product or service and an introductory launch plan.

Course Outcomes:
Upon completion of the course, students shall have ability to

C004.1	Understand the different stages involved in product development.	[R]
C004.2	Identify concept generation activities and summarize the methodology involved in concept selection and testing.	[U]
C004.3	Apply relative importance of customer needs in establishing product specifications in design for manufacturing.	[A]
C004.4	Devise innovative product development plan with environmental and societal consideration.	[Ap]

Course Contents:

INTRODUCTION: Importance of engineering design, New product development process, Product development Methodologies And Organization – Designing to codes and standards- Team Assignments Logistics - Identifying Market Opportunities Product Planning - Understanding Customer and User Needs- Strategic Planning and Opportunity Identification for new products.

DESIGN THINKING TECHNIQUES: Product Specifications - Product Architecture - Industrial Design - User Interface Design – Concept and Idea generation - Concept development Product and positioning - Prototyping - Program Management for Product - Development - Product Development Economics. TRIZ- axiomatic design. Pugh Concept selection. **DESIGN FOR MANUFACTURING:** Design for Manufacturing - Product Testing and Reliability - Simulation and Design Tools - Product Launch.

DESIGN FOR THE ENVIRONMENT: Design for the Environment - Product Lifecycle Management - Portfolio Management and Program Management Office. Human factors design. **NEW PRODUCT LAUNCH AND MARKET ENTRY:** Preparing a Launch Plan - Market Testing - Pricing, Packaging - Integrated Marketing - Innovation Marketing. Role of PLM in industries (Aero, Auto, Electronics).

Total Hours:	**45**

Text Books:

1	Ulrich, Karl, and Steven Eppinger. “Product Design and Development”, 5th. New York, Y: McGraw-Hill, 2015
2	Chitale, AK, Gupta, RC, “Product Design and Manufacturing” PHI, 2013.

Reference Books:

1	Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, , Tata McGraw-Hill Education, 2015.
2	Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint, Pearson Education, 2014.
3	George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009

Online Resources:

1	www.nptel.ac.in/courses/112107217/
2	https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2017/

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C004.1	Remember	Quiz	4
C004.2	Understand	Assignment	4
C004.3	Analyze	Case Study	4
C004.4	Apply	Presentation	8

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	40	30	20	20
Understand	40	40	40	30
Apply	20	20	20	30
Analyse	-	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C004.1	2		3		3	2		3	2				3	2
C004.2	2	3	3		3	2		1	2		3		3	2
C004.3	3	3	3		3	2		3	3	2	3		3	2
C004.4	1		3		2	3		2	3	2	3		3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME005	FUNDAMENTALS OF ADDITIVE MANUFACTURING	3/0/0/3
Nature of Course	Theory application	
Pre requisites	Engineering Physics, Engineering Chemistry and Engineering Graphics	

Course Objectives:

1.	To provide a detailed knowledge on advanced manufacturing techniques, the Additive manufacturing processes.
2.	To aid in understanding the need, types, application, method of operation and the future of AM system in industrial applications.
3.	To enhance innovative thinking and solve business case studies in AM technique.

Course Outcomes:

Upon completion of the course, students shall have ability to

C005.1	Understand the basic concepts of Additive manufacturing technologies along with recent trends in advanced manufacturing.	[U]
C005.2	Demonstrate different methods used for pre-processing and post processing of additive manufactured products.	[U]
C005.3	Application of additive manufacturing in automobile, aerospace and Bio-medical applications.	[Ap]
C005.4	Study complex componentsanddesign the product using additive manufacturing techniques.	[Ap]

Course Contents:

INTRODUCTIONTO RAPID MANUFACTURING:

Process requirements for Rapid Prototyping - Product Prototyping and Product Development - Prototyping - Need for Prototyping - Prototyping Materials-Rapid Prototyping Procedure -Issues in Prototyping - Conducting Prototyping – Design Procedure - Prototype Planning and Management - Product and Prototype Cost Estimation -Fundamentals of Cost Concepts - Prototype Cost Estimation- Reverse Engineering.

TYPES OF ADDITIVE MANUFACTURING PROCESS:

Types of AM Process - Stereolithography -Fused Deposition Modelling - Selective Laser Sintering -3D Printing Process, Polyjet printing - Laminated Object Manufacturing - Electron Beam MeltingProcess. Selective Laser Sintering-Fused Deposition Modeling,-Polyjet/inket printing/single/multi Layered object manufacturing-Digital Light Processing (DLP)-Metal Additive Manufacturing (SLM, Inkjet, etc), Sand/Ceramics Printing. Advanced materials - Electronic Materials, Bio printing-FoodPrinting.

APPLICATIONS OF ADDITIVE MANUFACTURING:

Investment casting – Sand casting – Permanent Mould casting – Direct RP tooling – Silicone Rubber Tooling – Investment Cast Tooling – Powder Metallurgy Tooling – Desktop Machining – Case studies on current application of AM – Novel Application of AM systems – Future trends of AM system. Application of AM in Medical, Automotive, Aeronautical, Space andConstructionIndustries.

Total Hours:	**45**

Text Books:

1.	C.K. Chua, K.F. Leong, C.S. Lim, “Rapid prototyping Principles & Application (3rd Edition), World Scientific Publication, 2018.
2.	Additive Manufacturing Design, Methods & Processes, Steinarkilli, Taylor & Francis Publication, 2017.

Reference Books:

1.	Liou, W.F., Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA, 2008.
2.	Hopkinson, N., Hague, R.J.M, and Dickens, P.M., Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK, 2006.

Web References:	
1	https://www.technosofteng.com
2	https://schooledbyscience.com
3	https://www.metal-am.com

Online Resources:	
1	http://nptel.ac.in/courses/112107077/382.
2	http://nptel.ac.in/courses/112107078/37
3	http://nptel.ac.in/courses/112102103/16

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C005.1	Understand	Objective type Quiz	5
C005.2	Understand	Assignment	5
C005.3	Apply	Case Study	5
C005.4	Apply	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	20	20
Understand	50	50	40	40
Apply	20	20	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C005.1	3	2	2										3	
C005.2	3	2	2								2		1	2
C005.3	3	2	2				2				2		2	
C005.4	3	2	2				2				2		3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME006	FUEL CELL TECHNOLOGY	3/0/0/3
Nature of Course	Theory and Application	
Pre Requisites	Engineering Physics Engineering Chemistry	

Course Objectives:

1	To enable students to understand the performance characteristics of fuel cell power plant and its components.
2	To outline the performance, design characteristics and operating issues for various fuel cells.
3	To impart sufficient knowledge to students about the working of fuel cell industry or R&D organization.

Course Outcomes:
Upon completion of the course, students shall have ability to

C006.1	Understand the fundamentals of fuel cell.	[U]
C006.2	Deduce the performance of fuel cell systems.	[A]
C006.3	Demonstrate the construction and operation of fuel cell stack and fuel cell system	[U]
C006.4	Illustrate the modelling techniques for fuel cell systems.	[Ap]
C006.5	Interpret the different methods of fuel processing for fuel cells.	[Ap]

Course Contents:

Overview of fuel cells and fuel cell electrochemistry Fuel cell – brief history – classification – need for fuel cell – fuel cell basic chemistry and thermodynamics - heat of reaction – theoretical electrical work and potential – theoretical fuel cell efficiency - Fossil fuels – basics of fuel processing – biofuels – hydrogen – hydrogen storage – electrode kinetics – types of voltage losses – polarization curve – fuel cell efficiency – Tafel equation – exchange currents.

Fuel cell process design Main PEM fuel cell components, materials, properties and processes – membrane, electrode, gas diffusion layer, bi-polar plates – fuel cell operating conditions – pressure, temperature, flow rates, humidity – main components of solid-oxide fuel cells – cell stack and design – electrode polarization – testing of electrodes – cells and short stacks – cell, stack and system modelling.

Fuel processing Direct and indirect internal reforming – reformation of hydrocarbons by steam – CO_2 and partial oxidation – direct electro-catalytic oxidation of hydrocarbons – carbon decomposition – sulphur tolerance and removal – using renewable fuels for SOFCs.

Total Hours:	**45**

Text Books:

1	Andrew L. Dicks and David A. J. Rand, “Fuel Cell Explained”, John Wiley & Sons. Inc., 2018.
2	Revankar shrip, “Fuel Cells: Principles, Design and Analysis”, Auerbach publications, 2014.
3	Dushyant Shekhawat, “Fuel Cells: Technologies for fuel processing”, North Holland Publishing Co., 2011.

Reference Books:

1	Ohayre, “Fuel Cell Fundamentals”, John Wiley & Sons Inc., 2016.
2	F. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 2013.
3	Kevin Huang, “Solid Oxide Fuel Cell Technology: Principles, Performance and Operations”, Woodhead Publishing Ltd., 2009.

Online Resources:

1	NPTEL course on “Non-conventional energy resources”.

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C006.1	Understand	Objective type Quiz	4
C006.2	Analyze	Case study	8
C006.3	Understand	Assignment	4
C006.4	Apply	Assignment	4
C006.5			

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	10	10	10	10
Understand	40	30	30	30
Apply	30	40	40	40
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C006.1		2	3					3	3	3	2			
C006.2	2	3			3			3	3	3	3		3	
C006.3		2	2							3	3		2	
C006.4		2	3							3	3		2	
C006.5	2		3					3	3	3	3		2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME007	LEAGILE APPROACH AND TECHNOLOGY MANAGEMENT	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Manufacturing Technology-I	

Course Objectives:

1	To acquire the general knowledge to deliver consistently high quality services to the customer in a stringent environment.
2	To improvise the value-added services by adopting leagile and sustainable strategies
3	To enable students to understand about various terms and applications related to lean, agile and sustainable management

Course Outcomes:
Upon completion of the course, students shall have ability to

C007.1	Examine the various methodologies of lean, agile and sustainable management applied in various sectors.	[R]
C007.2	Understand the implementation of leagile approach in manufacturing and transactional environment.	[U]
C007.3	Apply leagile and sustainable techniques to achieve competitive business culture for improving organization performance	[Ap]
C007.4	Reduce the defect ratio and to improve the sustainable performance of using various leagile strategies.	[A]

Course Contents:

Introduction to Leagile Approach: Introduction to Leagile Approach - Objectives of leagile approach - key principles and implications of leagile approach- Types of activities – Value Added, Non Value Added and Necessary but Non Value Added activities – Examples, Information Technology applications in leagile Manufacturing.

Strategies for Leagile Approach and Sustainability: Introduction to Lean Management, Comparison of Mass Manufacturing and Lean Manufacturing, Lean Principles, Types of Wastes – Seven basic categories, Lean tools, Fundamentals of Agile Management, Agile Principles, Conceptual models of Agile Strategy, Developing the agile enterprise, Managing People in agile organizations,–Scope, Need and Benefits Application Case studies on Leagile Approach.

Sustainability and Technology Management: Concepts of sustainability and sustainable development – Need for sustainable development - Components of sustainability- Social, Economic, Environmental dimensions - Linkages between technology and sustainability - Issues in managing new technology, Life cycle approach to technology management - Approaches to forecasting, Technology performance parameters - Organization structures and Technology Implementation issues in new technology – Technology Management issues

Total Hours:	**45**

Text Books:

1	Daniel Roos, Daniel T. Jones, and James P. Womack, “Machine That Changed The World”, Free Press, 2017 (Reprint).
2	Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India (PHI) Private Limited, New Delhi, India, 2012.
3	Joseph M. Putti, “Management – A Functional Approach”, McGraw Hill, 2016.
4	G. Atkinson, S. Dietz, E. Neumayer – “Handbook of Sustainable Manufacturing”. Edward Elgar Publishing Limited, 2012.

Reference Books:

1	Alan Robinson “Continuous Improvement in Operations”, Productivity Press, Portland, Oregon, 2015.

2	D. Rodick, “Industrial Development for the 21st Century: Sustainable Development Perspectives”, UN New York, 2014.
3	Gopalakrishnan “Simplified Lean Manufacture – Elements, Rules, Tools and Implementation”, PHI Learning Private Limited, New Delhi, India, 2010.
Web References:	
1	https://www.emerald.com/insight/content/doi/10.1108/17410381211196311/full/html
2	https://www.lean.org/
Online Resources:	
1	https://www.referenceforbusiness.com/management/Str-Ti/Technology-Management.html

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C007.1	Remember	Objective type Quiz	4
C007.2	Understand	Assignment	4
C007.3	Apply	Assignment	4
C007.4	Analyze	Mini Project	8
C007.5			

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	30	30
Understand	40	40	30	40
Apply	20	20	30	20
Analyze	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C007.1	3	3			3	3			2		3			3
C007.2	3	3			3	3		2	2		2		2	
C007.3	3	3	3		3	3		2	3		2		2	3
C007.4	3				3	3		2	1					2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Emerging electives

18ME008	INTERNET OF THINGS FOR MECHANICAL ENGINEERS	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Problem Solving Techniques and C Programming Electrical Drives and Microprocessor	

Course Objectives:	
1	To get acquainted with the building blocks of Internet of Things (IoTs), characteristics and taxonomy of IoT levels.
2	To impact the value creation for an industry using IoT.
3	To gain knowledge on the real time application of IoT.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C008.1	Understand the main components used in the world of IoT.	[U]
C008.2	Select the tools and technologies to create new Internet of Things solutions.	[Ap]
C008.3	Apply IoT in various fields like automobiles and transport system management	[Ap]
C008.4	Design and create IoT based systems for real time applications.	[C]

Course Contents:

Introduction to IoT: Introduction, History of IoT, About objects/things in the IoT, Enabling technologies of IoT, About the Internet in IoT. **Technologies behind the IoT:** Challenges and Issues, Security Control Units, Components in IoT -Sensors, Communication modules, Power Sources, Communication Technologies, RFID, Bluetooth, Zigbee, Wifi, Rflinks, Mobile Internet, Wireless Communication, Arduino boards, Data Monitoring using Arduino, Rasberry Pi.

Value Creation for Industry: Introduction to M2M, Architecture and Protocol of M2M, Smart Cards in M2M Communication, Value Creation and Challenges, Future Factory Concepts .Brownfield IoT- Technologies for Retrofitting, IoT for Oil and Gas Industry.

IoT for Automotive: Vehicle Utility control, Navigation, Tracking and Self driving cars, Smart parking, Intelligent transport system, Monitoring Driving Habits using smart phones, e-Call system, Electric Toll collection, Smart signals. **Application :** Smart Factory , Smart Objects, Environment- Weather Monitoring system, Air Pollution Monitoring , Forest Fire Detection, Smart Irrigation, Smart Connected System Design Case Study.

Total Hours:	**45**

Text Books:	
1	Honbo Zhou,"The Internet of Things in the Cloud:A Middleware Perspective", CRC Press,2016.
2	Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.

Reference Books:	
1	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things - key applications and Protocols", Wiley, 2016.
2	Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October, 2014.
3	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Web References:	
1	http://www.theinternetofthings.eu/what-is-the-internet-of-things
2	http://www.internet-of-things- research.eu

Online Resources:	
1	https://www.coursera.org/specializations/Internet-of-things

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C008.1	Understand	Quiz	5
C008.2	Apply	Case Study/ Group Assignment	5
C008.3			
C008.4	Create	Mini Project	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	30	20	20	20
Understand	40	40	40	40
Apply	30	40	30	30
Analyze	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C008.1	3	2	3		3		2	3	2	3				3
C008.2		3		3	3	2	2		2	3			2	
C008.3	3	3			2			2	2	3	3		2	3
C008.4	3	2		3					2	3	3			2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME009	DATA ANALYTICS FOR MECHANICAL ENGINEERS	3/0/0/3
Nature of Course	Theory	
Pre requisites	Probability, Statistics and Numerical methods.	

Course Objectives:

1	To enable the students to learn the principles of data analytics and decision making.
2	To enable the students to understand the concept of data exploration.
3	To prepare the students to apply statistical Inference.
4	To enable the students to analyze the scenario using probability and make decisions under uncertainty.

Course Outcomes:

Upon completion of the course, students shall have ability to

C009.1	Describe the properties of normal, binomial, poisson and exponential distributions and provide suitable examples for the same.	[R]
C009.2	Classify sample data to infer the properties of the entire population and analyze data files using Excel	[A]
C009.3	Determine the relationships between variables using hypothesis testing	[Ap]
C009.4	Identify decision variables that involve uncertainty and apply linear programming techniques to solve the variables	[A]
C009.5	Perform statistical analysis and apply management science techniques to make decisions.	[E]

Course Contents:

Introduction to Data Analysis & Decision Making: Introduction to Data Analysis and Decision Making, Describing the Distribution of a Single Variable, Finding Relationships among Variables, Probability and Decision Making under Uncertainty: Probability and Probability Distributions; Normal, Binomial, Poisson, and Exponential Distributions, Decision Making under Uncertainty.

Statistical Inference: Sampling and sampling distributions, hypothesis testing, Regression analysis: linear regression, logistic regression, time series analysis and forecasting, statistical reporting, advanced data analysis, data mining, structural equation modeling, cluster analysis, analyzing data with correspondence analysis.

Applications: Importing data into excel, analysis of variance and experimental design, Six Sigma for data analysis, QC tools for data interpretation, statistical reporting. R tool machine learning algorithm tools: SAS Eminer, Tableau public tool – Data visualization tool: SPSS, OTA analytics, Role of Data Analytics in Product Design and Inventory and Database Management.

Total Hours: 45

Text Books:

1	S. Albright , Wayne Winston,"Data Analysis and Decision Making", 2011.
2	Hamburg, M., and P. Young. Fort Worth, "Statistical Analysis for Decision Making", TX: Dryden Press, 2006.

Reference Books:

1	S. Christian Albright , Wayne Winston , Christopher Zappe, "Data Analysis and Decision Making with Microsoft Excel (with CD-ROM, InfoTrac, and Decision Tools and Statistic Tools Suite)", South-Western College Publishing, 2011.
2	Aczel Amir, Sounder pandian, Jayvel, "Complete Business Statistics", 6th Edition, Tata McGraw Hill, 2006.

Online Resources:	
1	www.coursera.org

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C009.1	Remember	Objective type Quiz	4
C009.2	Analyze	Assignment	4
C009.3	Apply	Tutorial	4
C009.4	Analyze	Group Assignment	8
C009.5	Evaluate		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	20	20
Understand	40	30	20	30
Apply	30	20	40	30
Analyze	-	20	10	10
Evaluate	-	-	10	10
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C009.1														3
C009.2	3	3			3			2	2		2		2	
C009.3	3	3	3		3			2	3		2		2	3
C009.4	3				3			2	1					2
C009.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME010	BASICS OF SOFT COMPUTING TECHNIQUES	3/0/0/3
Nature of Course	Theory analytical	
Pre Requisites	Industrial Engineering and Operations Management	

Course Objectives:

1	To introduce the idea of fuzzy sets, fuzzy logic and heuristics for solving problems.
2	To become familiar with neural networks and form appropriate rules for inferring the systems.
3	To provide the mathematical background for carrying out the optimization associated with neural network learning.
4	To familiarize with genetic algorithms and other random search procedures useful for seeking global optimum in self-learning situations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C010.1	Understand the basics of soft computing concepts and techniques.	[U]
C010.2	Discuss the supervised and unsupervised artificial neural networks and its applications.	[U]
C010.3	Apply various primitive operations on fuzzy sets with dynamic components.	[Ap]
C010.4	Apply genetic algorithms to combinatorial optimization problems.	[Ap]
C010.5	Analyse neural networks, fuzzy Logic, genetic algorithms and other hybrid algorithms.	[A]

Course Contents:

INTRODUCTION: Introduction to soft computing-Characteristics of Soft Computing-Advantages, Applications and Scope of Soft computing. Soft Computing Constituents and Conventional Artificial Intelligence introduction to: Biological and Artificial Neural Network-Fuzzy sets and Fuzzy logic systems Genetic Algorithm- Hybrid Systems. **ARTIFICIAL NEURAL NETWORK-** Basic Models and Terminologies of Artificial Neural Network-Supervised Learning Neural Networks: Perceptions-Adaptive Linear Neuron-Back propagation Multilayer Perception Applications. Learning from Reinforcement: Temporal Difference Learning-Art of Dynamic Programming-Q-Learning-Applications. Unsupervised Learning and other Neural Networks: Kohenen self-organizing Networks-Learning vector organization-Hebbian Learning-Hopfield Network-Applications.

FUZZY LOGIC: Fuzzy systems and applications: fuzzy sets- fuzzy reasoning- fuzzy inference systems- fuzzy control- fuzzy clustering- applications of fuzzy systems..-Case Study: Implement various primitive Operations on Fuzzy Sets with Dynamic components and verify the laws associated with fuzzy set. **GENETIC ALGORITHMS**- Simple GA-Classification of Genetic Algorithm- crossover and mutation- genetic algorithms in search and optimization-Applications: Pattern Recognitions- Image Processing- Biological Sequence Alignment and Drug Design- Robotics and Sensors- Information Retrieval Systems, Share Market Analysis-Natural Language Processing.

HYBRID SYSTEMS: Integration of Neural Networks, Fuzzy Logic, and Genetic Algorithms: Types of Hybrid systems: Sequential, Auxiliary and Embedded Hybrid systems, Neuro-fuzzy systems: neuro-fuzzy modeling-neuro-fuzzy control - Neuro Fuzzy Hybrids - Neuro-Genetic Hybrids ,Fuzzy-Genetic Hybrids-Genetic Algorithm based Back propagation Networks-Fuzzy Back propagation Networks-Simplified Fuzzy ARTMAP-Fuzzy Associative Memories-Fuzzy Logic controlled Genetic Algorithms-Applications.

Total Hours:	**45**

Text Books:

1	D.K. Pratihar and S.P. Simon, Soft Computing techniques, Oxford University Press, 2015.

2	S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2012.
Reference Books:	
1	D. K. Pratihar, “Soft Computing: Fundamentals and Applications”, Narosa Publishing House, New Delhi, 2015.
2	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India, 3rd edition, 2012.
Web References:	
1	https://web.iiit.ac.in/~srikanth/demonstration_of_various_soft_co.htm
Online Resources:	
1	https://nptel.ac.in/downloads/106105173/
2	https://nptel.ac.in/courses/106105173/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C010.1	Understand	Objective type Quiz	5
C010.2			
C010.3	Apply	Assignment	5
C010.4	Apply	Simple case study	10
C010.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	30	30	40	40
Apply	50	40	30	30
Analyze	-	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C010.1	3	2			3				2	3	3		2	
C010.2	3	2			2			2	2	3	2		2	
C010.3	3	2			2			2	3	3	2	2	2	3
C010.4	3				2			2	1	3	2	2		3
C010.5														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME011	EXPERT SYSTEM	3/0/0/3
Nature of Course	Theory Application	
Pre Requisites	Nil	

Course Objectives:

1	To study the basic concepts of artificial intelligence and neural network techniques.
2	To familiarize with the various steps involved in applying Artificial Intelligence.
3	To understand the basic concepts of Expert Systems.
4	To develop an expert systems for given knowledge base.

Course Outcomes:
Upon completion of the course, students shall have ability to

C011.1	To understand and express the fundamental results and problems in several sub-disciplines/domains of artificial intelligence and expert systems	[U]
C011.2	To conduct intensive problem-solving and inquiry based efforts over several days to formulate proto-types of AI domain constructs.	[Ap]
C011.3	To apply their background in calculus and probability & statistics to formulate probabilistic models of intelligent systems such as expert systems, neural nets and Bayesian inference systems.	[Ap]
C011.4	To apply classical logic in AI context after introduction to mechanized resolution- based inference and theorem proving, to solve logic problems of progressively more complex natures.	[Ap]

Course Contents:

EXPERT SYSTEMS: Expert Systems – Introduction – Difference between expert system and conventional programs. Basic activities of expert system-Interpretation-Prediction-Diagnosis-Design-Planning –Monitoring –Debugging-Repair-Instruction-Control-Basic Aspects of expert system – Acquisition module frames –Knowledge base, Production rules-Semantic net, Interference Engine –Backward chaining and forward chaining – Explanatory interface.

INTRODUCTION TO AI AND PRODUCTION SYSTEMS: Introduction To AI-Problem Formulation, Problem Definition -Production Systems, Control Strategies, Search Strategies. Problem Characteristics, Production System Characteristics -Specialized Production System-Problem Solving Methods – Problem Graphs, Matching, Indexing And Heuristic Functions -Hill Climbing-Depth First And Breath First, Constraints Satisfaction – Related Algorithms, Measure Of Performance And Analysis Of Search Algorithms.

KNOWLEDGE INFERENCE: Knowledge Representation -Production Based System, Frame Based System. Inference – Backward Chaining, Forward Chaining, Rule Value Approach, Fuzzy Reasoning – Certainty Factors, Bayesian Theory-Bayesian Network-Dumpster – Shafer Theory. **PLANNING AND MACHINE LEARNING:** Basic Plan Generation Systems – Strips - Advanced Plan Generation Systems – K Strips -Strategic Explanations -Why, Why Not And How Explanations. Learning- Machine Learning, Adaptive Learning.

Total Hours:	**45**

Text Books:

1	D.W. Rolston,- Principles of AI & Expert System Development, TMH, New Delhi.2018
2	Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2016.

Reference Books:

1	E. Rich & K. Knight - Artificial Intelligence, 2/e, TMH, New Delhi, 2017.
2	P.H. Winston - Artificial Intelligence, 3/e, Pearson Edition, New Delhi, 2014.

Web References:

1	www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_overview.html

Online Resources:	
1	https://nptel.ac.in/courses/106105077/25
2	https://nptel.ac.in/courses/106105077/17

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C011.1	Understand	Assignment	10
C011.2	Apply		
C011.3,4	Apply	Case study	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C011.1	3			2	3			3	3	2	3			3
C011.2	3	2		2				2	2		2		2	
C011.3	3	2		3					2		3		2	3
C011.4	3				2			1			2			2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME012	FUNDAMENTALS OF MACHINE LEARNING	3/0/0/3
Nature of Course	Theory Concept	
Pre requisites	Problem Solving using C Programming	

Course Objectives:

1	To introduce fundamental concepts of Machine Learning.
2	To understand the basic of supervised and unsupervised learning.
3	To study various models of machine learning algorithms.

Course Outcomes:

Upon completion of the course, students shall have ability to

C012.1	Understand the basics of Machine Learning.	[U]
C012.2	Apply the apt machine learning strategy for any given problem.	[Ap]
C012.3	Analyze the supervised, unsupervised and semi-supervised learning.	[A]
C012.4	Analyze the graphical model of machine learning algorithm.	[A]

Course Contents:

INTRODUCTION TO MACHINE LEARNING: Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm.

LINEAR MODELS: Linear Models for regression - Linear basis function models, Bayesian linear regression - Linear Models for classification - Discriminant Functions, Probabilistic Generative Classifiers and Probabilistic Discriminative Classifiers. **NON-LINEAR MODELS:** Model Selection & Decision Trees, Ensemble Classifiers, Neural Networks, Multilayer Perceptron, Network training, Error back-propagation, Instance-based Learning, K-NN, Case-based Reasoning.

TREE AND PROBABILISTIC MODELS: Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models -Unsupervised Learning – K means Algorithms. **GRAPHICAL MODELS:** Markov Chain Monte Carlo Methods - Bayesian Networks – Markov Random Fields – Hidden Markov Models.

Total Hours:	**45**

Text Books:

1	Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2	Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.

Reference Books:

1	Jason Bell, Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.
2	Ethem Alpaydin, Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.

Web References:

1	https://onlinecourses.nptel.ac.in/noc17_cs26/preview

Online Resources:

1	https://www.coursera.org/learn/machine-learning#syllabus

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C012.1	Understand	Objective type Quiz	5
C012.2	Apply	Assignment	10
C012.3	Analyze	Seminar	5
C012.4		Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	10	10	10	10
Understand	20	20	20	30
Apply	40	40	40	40
Analyze	30	30	30	20
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C012.1	3			2	2			2	3	3	3			3
C012.2	3	2		2				2	3		2		2	3
C012.3	3	2		3					2		3		2	3
C012.4	3				3			2			2			3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME013	PRODUCT LIFECYCLE MANAGEMENT	3/0/0/3
Nature of Course	Theory	
Pre requisites	CAD/CAM laboratory	

Course Objectives:

1	To acquire knowledge on the principles, best practices, current advancements and applications of Product Lifecycle Management.
2	To study about all aspects of a product's life cycle from "design phase" to "end of life phase".
3	To understand and experience effective integration of PLM technologies into product development process that provides competitive advantage to industries of various sectors to deliver innovative products.

Course Outcomes:

Upon completion of the course, students shall have ability to

C013.1	Familiarize with the fundamentals of product lifecycle and thus acquire the capability to apply them.	[R]
C013.2	Understand about the methods and technologies for adopting PLM strategies.	[U]
C013.3	Manage and analyze the challenges in different stages of product development.	[A]
C013.4	Apply the tools/techniques of product lifecycle management to industrial problems.	[Ap]

Course Contents:

MOTIVATION AND INTRODUCTION: Product Lifecycle -Definition, Need and Overview; Elements; Stages; Corporate Challenges; E-Commerce -B To B, B ToC Forms of Business, Extended Enterprise**,** Product Data Management -CIM Data, PDM Functions, Definition And Architectures Of PDM Systems, Information Flow Model In Product Development, Engineering Bill Of Materials And Manufacturing Bill Of Materials.

PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES: Integrated Product development process Conceive – Specification, Concept design, Design - Detailed design, Validation and analysis, Concurrent engineering - work structuring and team Deployment, Product Modeling - Definition of concepts - Fundamental issues - Role of Process chains and product models, Value engineering in product design. **Introduction to product design** tools - FMEA, QFD, Computer Aided Design, DFM, DFA, Ergonomics in product design, Product launch & engineering change, Sustainable design.

ENABLING TECHNOLOGIES AND RECENT ADVANCEMENTS: Business Process Reengineering; Enterprise Resource Planning; Managing a design project; Introduction to Digital Manufacturing; Applications of soft computing in product development process; PLM Softwares; Use of visualization in several stages of lifecycle – Case studies.

Total Hours: 45

Text Books:

1	Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.
2	John Stark, "Product Lifecycle Management: 21 Century Paradigm for Product Realisation", Springer Publisher, 2005.
3	Kevin N Otto and Kristin L Wood, "Product Design", Pearson, 2001.

Reference Books:

1	Stark, J., Product Lifecycle Management - 21st Century Paradigm for Product Realisation, Springer-Verlag, London, 2005

2	Saaksvouri, A. and Immonen, A., Product Lifecycle Management, 3rd Ed., Springer, 2008.
3	Abele, E. et al., Environmentally-friendly Product Development Methods and Tools, Springer, 2005.
4	Burden, Rodger PDM: Product Data Management, Resource Pub, 2003.
Web References:	
1	www.cimdata.com
2	www.aberdeen.com
Online Resources:	
1	https://nptel.ac.in/courses/110104070/9
2	https://nptel.ac.in/courses/112107217/2

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C013.1	Remember	Objective type Quiz	5
C013.2	Understand	Assignment	5
C013.3	Analyze	Lab Tutorial	5
C013.4	Apply	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	30	20	20
Understand	50	50	50	50
Apply	20	20	20	20
Analyze	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											PSOs		
	a	b	c	d	e	f	g	h	i	j	k	1	2	3
C013.1	3	3			3				2	3	3			3
C013.2	3	3			3			2	2	3	2		2	
C013.3	3	3	3		3			2	3	3	2		2	3
C013.4	3				3			2	1	3				2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Service subjects

18ME102	ENGINEERING PRACTICES LABORATORY	1/0/4/3

Nature of Course: M (Practical application)

Pre Requisites: Nil

Course Objectives:

1. To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2. To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.

Course Outcomes

C102.1	Identify and solve the basic engineering problems at home and in workplace.	[Ap]
C102.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C102.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[Ap]
C102.4	Prepare pipe connections and sand moulds.	[Ap]
C102.5	Understand the fundamentals of machining.	[U]
C102.6	Examine and troubleshoot electrical and electronic circuits	[A]

Course Content:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods –Sheet metal operations - Welding - arc welding , gas welding , TIG & MIG welding — basic machining using lathe - metal casting - Carpentry work using power tools - Plumbing components and pipelines

List of Experiments:

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of butt joints and lap joints using arc welding and TIG / MIG welding.	C102.3	[Ap]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C102.2	[Ap]
3	Preparation of wooden joints by sawing, planning and cutting.	C102.3	[Ap]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C102.4	[Ap]
5	Basic machining - simple turning operations.	C102.5	[U]
6	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C102.4	[Ap]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipments: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder.

S.No	List of Experiments	CO Mapping	RBT
1	Study and identification of electronic components with specification.	C102.6	[A]
2	Testing of CRO and Electronic components using Multimeter.	C102.6	[A]

3	Generation and measurement of signals using CRO.	C102.6	[A]
4	Familiarisation of digital basic gate IC's.	C102.6	[A]
5	Soldering practice-components devices and circuits- using general purpose PCB.	C102.6	[A]
6	Demonstration of meters and electrical components.	C102.6	[A]
7	Safety precautions with electrical components.	C102.6	[A]
8	Residential house wiring.	C102.6	[A]
9	Measurement of power and energy.	C102.6	[A]
10	Trouble shooting of electrical equipments.	C102.6	[A]
		Total Hours	45

Reference Books:

1. SeropeKalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2. Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014.
3. Suyambazhagan S, 'Engineering practices' PHI Learning private limited, New Delhi,2012.
4. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Web References:

1. www.nptel.ac.in
2. www.sme.org
3. http://www.allaboutcircuits.com/education/

Blooms Taxonomy based Assessment Pattern:

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks]**	**End Semester Examination [40 marks]**
Remember	10	10
Understand	10	10
Apply	40	40
Analyze	20	20
Evaluate	10	10
Create	10	10

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C102.1	3	3	3		3		3		3	2		1	3	
C102.2	3	3	3		3		3		3	2		1	3	
C102.3	2	1	3	2	3			3	2		1	1		
C102.4														
C102.5														
C102.6														

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

18ME111	ENGINEERING GRAPHICS	2/0/2/3

Nature of Course: M (Practical application)

Pre Requisites: Basic Drawing and Computer Knowledge

Course Objectives:

1. To know the method to construct the conic curves used in Engineering Applications.
2. To develop an understanding of Isometric to Orthographic Views and vice versa.
3. To learn the basic projection of straight lines and plane surfaces.
4. To develop the imagination of solids inclined to one reference plane.
5. To know the development of surfaces used in various fields

Course Outcomes

C111.1	Understand the basic concepts of Engineering Graphics.	[U]
C111.2	Sketch isometric, orthographic projections and projection of lines and planes	[Ap]
C111.3	Develop lateral surfaces of solids including prisms and pyramids	[Ap]
C111.4	Construct projections of lines, planes, solids and isometric views using modelling software.	[A]

Course Contents

Conic curves and Special curves-Isometric to Orthographic projection-Orthographic to Isometric projection-Projection of Lines and Plane surfaces-Projection of Solids-Development of Surfaces-Introduction to Perspective projection.

S.No	List of Experiments	CO Mapping	RBT
1	Introduction to Drafting Software.	C111.1	U
2	Construction of Conic Curves (Ellipse, Parabola and Hyperbola)	C111.1	U
3	Construction of Special Curves (Cycloid and Involutes)	C111.1	U
4	Isometric to Orthographic projections – Manual sketches	C111.2	Ap
5	Isometric to Orthographic projections – Software sketches	C111.4	A
6	Projection of lines - Inclined to HP, VP and Both HP & VP	C111.4	A
7	Projection of Plane surfaces (Hexagon, Pentagon and circle) – inclined to any one of the principle planes	C111.4	A
8	Projection of Solids (Prism and Pyramid) – Inclined to HP	C111.3	Ap
9	Projection of Solids (Cone and Cylinder) – Inclined to VP	C111.3	Ap
10	Development of Surfaces (Prism, Pyramid, Cone and Cylinder)	C111.4	A
11	Introduction to Perspective projection	C111.2	U
	Total Hours		45

Reference Books:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.
2. K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2013.

Web References:

1. http://nptel.ac.in/courses/112102101/

2. www.solidworks.com

Blooms Taxonomy based Assessment Pattern:

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks]**	**End Semester Examination [40 marks]**
Remember	30	30
Understand	30	30
Apply	20	20
Analyze	20	20
Evaluate	0	0
Create	0	0

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**	**2**	**3**
C111.1	2	2	1				2	2	3		2	3	2	
C111.2	2	2	1				2	2	3		2	3	2	
C111.3	2	2	1				2	2	3		2	3	2	
C111.4	2	2	1				2	2	3		2	3	2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed