NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Affiliated to

DR.A.P.J. ABDUL KALAMTECHNICAL UNIVERSITY UTTAR PRADESH, LUCKNOW

Evaluation Scheme & Syllabus

For

Bachelor of Technology

Mechanical Engineering

Third Year

(Effective from the Session: 2022-23)

NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Bachelor of Technology
Mechanical Engineering
EVALUATION SCHEME
SEMESTER-V

SI. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	AME0501	Heat and Mass Transfer	3	1	0	30	20	50		100		150	4
2	AME0502	Theory of Machines	3	1	0	30	20	50		100		150	4
3	AME0503	Applied Industrial IOT	3	0	0	30	20	50		100		150	3
4	ACSE0503	Design Thinking-II	2	1	0	30	20	50		100		150	3
5		Departmental Elective -I	3	0	0	30	20	50		100		150	3
6		Departmental Elective -II	3	0	0	30	20	50		100		150	3
7	AME0551	Heat and Mass Transfer Lab	0	0	2				25		25	50	1
8	AME0552	Theory of Machines Lab	0	0	2				25		25	50	1
9	AME0553	Applied Industrial IOT Lab	0	0	2				25		25	50	1
10	AME0559	Internship Assessment-II	0	0	2				50			50	1
11	ANC0501 / ANC0502	Constitution of India, Law and Engineering / Essence of Indian Traditional Knowledge	2	0	0	30	20	50		50		100	
		MOOCs (For B.Tech. Hons. Degree)											
		Total										**1100**	**24**

List of MOOCs (Coursera) Based Recommended Courses for Third Year(Semester-V) B. Tech. Students

S.No.	Subject Code	Course Name	University/Industry Partner Name	No of Hours	Credits
1	AMC0072	Design-Led Strategy: Design thinking for business strategy and entrepreneurship	The University of Sydney.	20	1.5
2	AMC0087	Introduction to Machine Learning	Duke University.	26	2

PLEASE NOTE:-

- **Internship (3-4 weeks) shall be conducted during summer break after semester-V and will be assessed during semester-VI**

- **Compulsory Audit Courses (Non Credit - ANC0501/ANC0502)**
  - All Compulsory Audit Courses (a qualifying exam) has no credit.
  - Total and obtained marks are not added in the Grand Total.

Abbreviation Used: -

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., PE: Practical End Semester Exam.

List of Departmental Electives

Sl. No.	Departmental Electives	Subject Codes	Subject Name	Bucket Name	Branch	Semester
1	Elective-I	AME0511	Internal Combustion Engine	**Automotive Engineering**	ME	5
2	Elective-II	AME0513	Power Plant Engineering		ME	5
3	Elective-I	AME0512	Mechatronics Systems	**Industry 4.0**	ME	5
4	Elective-II	AME0514	Computer Aided Engineering		ME	5

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Bachelor of Technology
Mechanical Engineering
EVALUATION SCHEME
SEMESTER-VI

SI. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	AME0601	Design of Machine Elements	3	1	0	30	20	50		100		150	4
2	AME0602	Refrigeration and Air-Conditioning	3	1	0	30	20	50		100		150	4
3	AME0603	Industrial Engineering	3	0	0	30	20	50		100		150	3
4		Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Departmental Elective-IV	3	0	0	30	20	50		100		150	3
6		Open Elective-I	3	0	0	30	20	50		100		150	3
7	AME0651	Machine Design Lab	0	0	2				25		25	50	1
8	AME0652	Refrigeration and Air-Conditioning Lab	0	0	2				25		25	50	1
9	AME0654	AI & ML Lab	0	0	2				25		25	50	1
10	AME0659	Mini Project	0	0	2				50			50	1
11	ANC0602 / ANC0601	Essence of Indian Traditional Knowledge / Constitution of India, Law and Engineering	2	0	0	30	20	50		50		100	
		MOOCs (Essential for Hons. degree)											
		Total										**1100**	**24**

List of MOOCs (Coursera) Based Recommended Courses for Third Year (Semester-VI) B. Tech. Students

S.No.	Subject Code	Course Name	University/Industry Partner Name	No of Hours	Credits
1	AMC0093	Machine Learning with Python	IBM	23	1.5
2	AMC0097	Advanced Manufacturing Enterprise.	University at Buffalo, The State University of New York.	18	1

PLEASE NOTE:-

- **Internship (3-4 weeks) shall be conducted during summer break after semester-VI and will be assessed during semester-VII.**
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- **Compulsory Audit Courses (Non Credit - ANC0601/ANC0602)**
  - All Compulsory Audit Courses (a qualifying exam) has no credit.
  - Total and obtained marks are not added in the Grand Total.

Abbreviation Used: -

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., PE: Practical End Semester Exam.

List of Departmental Electives

Sl. No.	Departmental Electives	Subject Codes	Subject Name	Bucket Name	Branch	Semester
1	Elective-III	AME0611	Hybrid Vehicles and Propulsion	**Automotive Engineering**	ME	6
2	Elective-IV	AME0613	Vehicle Body Engineering		ME	6
3	Elective-III	AME0612	Rapid Prototyping and Manufacturing	**Industry 4.0**	ME	6
4	Elective-IV	AME0614	Product Lifecycle Management		ME	6

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Bachelor of Technology
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AICTE Guidelines in Model Curriculum:

A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Coursera certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B. Tech. Program Guidelines for credit calculations are as follows.

1. For 6 to 12 Hours =0.5 Credit
2. For 13 to18 =1 Credit
3. For 19 to 24 =1.5 Credit
4. For 25 to 30 =2 Credit
5. For 31 to 35 =2.5 Credit
6. For 36 to 41 =3 Credit
7. For 42 to 47 =3.5 Credit
8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Coursera registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only.

The students shall be awarded Honours Degree as per following criterion.

i. If he / she secures 7.50 as above CGPA.
ii. Passed each subject of that degree program in the single attempt without any grace.
iii. Successful completion of MOOCs based 20 credits.

Mechanical Engineering Third Year

Course Code	AME0501	L T P	Credit
Course Title	HEAT AND MASS TRANSFER	3 1 0	4

Course objective:

1	Learn the concept of heat transfer.	K1
2	Learn about heat loss from a surface.	K4
3	Learn about radiation and how to minimize the effect of radiation.	K4
4	Learn about the boiling, condensation and application of heat exchanger in industry.	K4
5	Learn about mass diffusion and its application in health equipment's.	K5

Pre-requisites: Basic of Thermodynamics, Differentiation, Integration

Course Contents / Syllabus

UNIT-I Conduction — 10 hours

Introduction to Heat Transfer:

Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials.

Conduction:

General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions.

Steady State one-dimensional Heat conduction:

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.

UNIT-II Fins and Transient Heat conduction — 7 hours

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.

UNIT-III Convection — 10 hours

Free and Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations, Liquid metal heat transfer

Natural Convection: Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, combined free and forced convection.

UNIT-IV Thermal Radiation — 10 hours

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchhoff's law; Gray body; Shape factor; Black body-radiation; Radiation exchange between diffuse nonblack bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Error in temperature measurement; Absorption and emission in gaseous medium; Solar radiation.

UNIT-V Miscellaneous Heat Transfer — 11 hours

Heat Exchangers:

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

Condensation and Boiling: Introduction to condensation phenomena; types of condensation, Heat transfer relations for

laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Dropwise condensation; Heat pipes; Boiling modes, pool boiling.

Introduction to Mass Transfer:

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film, diffusion in Hemodialysis

Course outcome:

CO 1	Identify different modes of heat transfer and apply the governing law to calculate rate of heat transfer.	K1
CO 2	Solve the problems of Heat conduction and convection related to plane wall, composite cylinders, spheres, Extended surfaces, and their application in different industry.	K5
CO 3	Model problem for convective heat transfer coefficient, Analyze boiling and condensation related problems and their application to industry.	K5
CO 4	Analysis of radiation heat transfer problems and understanding its effect on global warming and gas emission.	K4
CO 5	Solve the problems of heat exchangers and analyze different design criteria of heat exchangers.	K4

Textbooks:

1. Heat and Mass Transfer by Cengel, McGraw-Hill
2. A Textbook on Heat Transfer, by Sukhatme, University Press.
3. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
4. Heat and Mass Transfer by R K Rajput, S Chand Publication.

Reference Books

1. Fundamentals of Heat and Mass Transfer, by Incroperra & DeWitt, John Wiley and Sons
2. Heat Transfer by J.P. Holman, McGraw-Hill

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	**Shorturl.at/jnpBP** **Shorturl.at/eoqW0** **Shorturl.at/nptGM** **Shorturl.at/EKTZ1** **shorturl.at/elT12**
Unit 2	Shorturl.at/bGLU5 Shorturl.at/hEM29 Shorturl.at/abgjU shorturl.at/ilrtV
Unit 3	Shorturl.at/dnoqT Shorturl.at/rSWZ9 Shorturl.at/cfQW2 https://www.youtube.com/watch?v=eUMLUu52bF8&list=PL5F4F46C1983C6785&index=21 https://www.youtube.com/watch?v=BilVxT0lW7U&list=PL5F4F46C1983C6785&index=22
Unit 4	**https://www.youtube.com/watch?v=CDncSyDvpdQ&list=PL5F4F46C1983C6785&index=10** **https://www.youtube.com/watch?v=CDncSyDvpdQ&list=PL5F4F46C1983C6785&index=10** **https://www.youtube.com/watch?v=fnEu5g8V-5s&list=PL5F4F46C1983C6785&index=12** **https://www.youtube.com/watch?v=atQ-SWZFWF4&list=PL5F4F46C1983C6785&index=13** **https://www.youtube.com/watch?v=ipoMla2UvKE&list=PL5F4F46C1983C6785&index=14**
Unit 5	**https://www.youtube.com/watch?v=jc_hL_tSFzo&list=PL5F4F46C1983C6785&index=25** **https://www.youtube.com/watch?v=Kj0ebo-vVAg&list=PL5F4F46C1983C6785&index=26** **https://www.youtube.com/watch?v=GrCbRHTeNBw&list=PL5F4F46C1983C6785&index=27** **https://www.youtube.com/watch?v=y5MX_gawtVQ&list=PL5F4F46C1983C6785&index=28** **https://www.youtube.com/watch?v=6OGnB9tywtI&list=PL5F4F46C1983C6785&index=29** **https://www.youtube.com/watchv=WR3sVzPMBTY&list=PL5F4F46C1983C6785&index=30**

Mechanical Engineering Third Year					
Course Code	AME0502	**L**	**T**	**P**	**Credit**
Course Title	**THEORY OF MACHINES**	**3**	**1**	**0**	**4**

Course objective:

1	Study, analyze, identify and interpret various mechanisms and machines to design linkage or mechanism with their inversions for industrial equipment that meets desired specifications and requirements.	**K_1, K_2**
2	Demonstrate and perform mechanism analysis by using both graphically and analytically to find the position, velocity, acceleration and forces of multi-bar mechanisms used in modern machinery.	**K_3, K_4**
3	Study and design basic cam, gear and gear train mechanism for desired motion for power transmission.	**K_2, K_3**
4	Study, identify and analyze the static and dynamic forces on the systems of linkage mechanism such as engine and also analyze a machine or engine fitted with flywheel.	**K_3, K_4**
5	Study and identify the causes of an unbalance system due to rotating and reciprocating masses used in various machinery and also study the role of governor.	**K_4**
6	Study and demonstrate the gyroscopic effect and its effect on the stability of aero-plane and ship.	**K_3**

Pre-requisites:

Basic knowledge of Engineering Mechanics
Basic knowledge of Engineering Mathematics
Basic knowledge of Engineering Graphics

Course Contents / Syllabus

UNIT-I Mechanisms, Velocity and Acceleration — 10 hours

Mechanism:

Introduction, mechanisms and machines, kinematics and kinetics, kinematic link and its types, kinematic pairs and their classification, kinematic chain, constraint motion, degrees of freedom of planar mechanism, Grobler's equation, inversion of four bar chain, single slider crank chain and double slider crank chain.

Velocity Analysis:

Introduction, velocity of point in mechanism, relative velocity and instantaneous centre method, Kennedy's theorem, velocities in four bar and slider crank mechanism.

Acceleration Analysis:

Introduction, acceleration of a point on a link, Coriolis's component of acceleration, acceleration in four bar and slider crank mechanism, crank and slotted lever mechanism.

UNIT-II Cam, Follower and Gears — 8 hours

Cam and Follower:

Introduction, classification of cams and followers, terminology of cam, cam profiles for knife edge, roller and flat faced followers for uniform velocity, simple harmonic motion, uniform acceleration and retardation.

Gears and Gear Trains:

Introduction, classification of gears, terminology of gear, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact and arc of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and epicyclic gear trains.

UNIT-III Force Analysis and Flywheel — 8 hours

Force Analysis:
Static force analysis of mechanisms, D'Alembert's principle, dynamic force analysis of planar mechanisms, engine force analysis, piston effort, crank effort and turning moment on crankshaft.

Flywheel:
Flywheels and its function, turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, fluctuation of energy and speed, energy stored by flywheel.

UNIT-IV	Balancing and Governors	8 hours

Balancing:
Introduction, static balancing and dynamic balancing, balancing of rotating masses in same plane and different plane, graphical and analytical methods, balancing of reciprocating masses.

Governor:
Introduction, governor and its function, types of governors, centrifugal governors and inertia governors, dead weight and spring controlled centrifugal governors, sensitivity and stability of governor, isochronous governor, hunting of centrifugal governors, effort and power of governor.

UNIT-V	Gyroscope	8 hours

Gyroscope:
Gyroscopic couples, Gyroscopic stabilization of shaft bearing, aero plane and ships, stability of four wheel and two-wheel vehicles moving on curved paths.

Dynamometers:
Dynamometers, types of dynamometers, prony brake and rope brake dynamometer, belt transmission, epicyclic and torsion dynamometer.

Course outcome: After completion of this course students will be able to

CO 1	Design linkage or mechanism with their inversions for industrial equipment that meets desired specifications and requirements and Perform mechanism analysis to find the position, velocity, acceleration, and dynamics of multi-bar mechanisms.	**K_1, K_2**
CO 2	Calculate the amount of power transmission through the gear drive and calculate their driving efficiencies.	**K_3, K_4**
CO 3	Understand balancing of reciprocating and rotary masses through solving engineering problems.	**K_2, K_3**
CO 4	Analyze static and dynamic force analysis of various mechanism and design of flywheel.	**K_3, K_4**
CO 5	Understand the gyroscopic forces and couple and its effect on the stability of aero-plane and ship.	**K_3**

Text books

1. Theory of Machines - S.S. Rattan, McGraw Hill
2. Theory of Machines - R. K. Bansal, Laxmi Publications
3. Theory of Machines - Khurmi & Gupta, S. Chand Publication
4. Mechanics of Machines - V. Ramamurti, Alpha Science
5. Kinematics of Machines - Dr. Sadhu Singh, S.K. Kataria & Sons
6. Theory of Machines and Mechanisms - Rao & Dukkipati, bohem press.
7. Theory of Machines - V. P. Singh, Dhanpat Rai Publishing Co. Pvt. Ltd.

Reference Books

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
3. Theory of Machines - Thomas Bevan, CBS Publishers.

Unit 1	https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8 https://www.youtube.com/watch?v=dT-0HzgmudU

	https://www.youtube.com/watch?v=-PRgEFcPStA
Unit 2	https://www.youtube.com/watch?v=oQrcPiQuCHI https://www.youtube.com/watch?v=BjkxYZ93Fbs
Unit 3	https://www.youtube.com/watch?v=fEdz91oWrts https://www.youtube.com/watch?v=oZhR1HPdvR4
Unit 4	**https://www.youtube.com/watch?v=CI9xMNvTLFI** **https://www.youtube.com/watch?v=OlZXxPVpmBs**
Unit 5	**https://www.youtube.com/watch?v=FydJu1A1oeM** **https://www.youtube.com/watch?v=ty3O5CNaMy8**

Mechanical Engineering Third Year

Course Code	AME0503	L	T	P	Credit
Course Title	Applied Industrial IoT (AIIoT)	3	0	0	3

Course objective:

1	To familiarize students with the concept of IIoT	K_2, K_3
2	To make students understand how to apply the concepts of IIoT	K_2, K_3, K_4
3	Students will be able to understand the applications of IIoT	K_2, K_3,

Pre-requisites: Students should have basic knowledge of sensors, electronic devices, control systems and basic coding/programming

Course Contents / Syllabus

UNIT-I	Introduction to Industrial IoT and Its Architecture	10 hours

Introduction to Industrial IoT

Concept of Internet of Things – Drivers, Benefits and Challenges of IOT – Categories of IoT – Examples of IoT in Industry

Industrial IoT Architecture

Information and Operational Technology – Layers of IIoT Architecture – Functions of IIoT Architecture Layers – Demo of practical use cases – Components of IIoT Architecture – Introduction to On-premise servers and Cloud – Review of Components in various layers of IoT

UNIT-II	Data Acquisition	8 hours

Data Acquisition

Fundamentals of Sensors – Types of Sensors – Some Common Sensors – Choosing a Sensor – Sensor Technologies – Thermal Sensors – Pressure, Shear and Photo Sensor – Electrical, Magnetic and Mechanical Sensors – Introduction to Measurements – Direct Measurement, Indirect Measurement, Derived Measurement – Measurement from Industrial Systems

UNIT-III	Edge Computing, The Gateway and IoT Connectivity Protocols	10 hours

Edge Computing and The Gateway

Edge Computing – Gateway Overview – Types and Features of Gateway – Selecting a Gateway – IoT Gateway – Choice of Gateway – Configuring the Gateway – lot Video Analytics and Quality Control at the Edge

IoT Connectivity Protocols

IoT Connectivity Overview – Wireless Long Range (WAN) Protocols – Practical examples – LAN Protocols – Serial Protocols – Optical Networks – Transmission Protocols in IoT – Wired LAN and Fiber Optic Protocols – Serial Protocols in IIoT Solutions

UNIT-IV	Platform Architecture	8 hours

Platform Architecture

Types of Server Architecture – Data Architecture – Data Ingestion and Stream Processing – Smart Monitoring of Diesel Generators – Big Data Architecture and Stream Processing – Storage Devices – Storage Technologies – Storage Dimensioning – Database – Monitor and Control Schedule, Cost and Resources – Analytics Overview – Types of Analytics – Algorithms and Machine Learning – Visualization

UNIT-V	IIoT Security	6 hours

IIoT Security

IIoT Security Concerns – IIoT Device Security – IIoT Connection Security – IIoT Application Platform and Cloud Security – Threat Modeling – Industrial Example: IoT Connected Workplace Solution

Course outcome:

CO 1	Link IoT with Industry 4.0, real world situations, daily life and recognize the architecture of IIoT	K_2, K_3

CO 2	Identify the right components needed for data acquisition and recognize how to utilize them.	K_2, K_3, K_4
CO 3	Define the functionalities required in edge computing and the gateway and also understand the concept of connectivity protocols.	K_2, K_3,
CO 4	Explain and classify the platform architecture focused on server and data architecture, also analyze data for business decisions.	K_2, K_3, K_4
CO 5	Foresee possible security threats in IIoT and identify solutions to overcome them.	K_2, K_3

Text books :

1. Olivier Hersent, DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocol willey
2. Jeeva Jose, Internet of Things, Khanna Publishing House
3. Michael Miller "The Internet of Things" by Pearson 4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016
5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications, 2014
6. Adrian McEwen, Hakin Cassimally "Designing the Internet of Things" Wiley India

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	**https://www.youtube.com/watch?v=LlhmzVL5bm8** **https://www.youtube.com/watch?v=bhDA7x3MAMQ**
Unit 2	**https://www.youtube.com/watch?v=bkq8Te4FnbI&ab_channel=EyeonTech** **https://www.youtube.com/watch?v=TPowbUhf0_Q&ab_channel=Ekeeda** **https://youtu.be/ZKSxOB8jtmY**
Unit 3	**https://www.youtube.com/watch?v=bkq8Te4FnbI&ab_channel=EyeonTech** **https://www.youtube.com/watch?v=7eNU4rvdTC0&ab_channel=MAKERDEMY**
Unit 4	**shorturl.at/aejs3**
Unit 5	**https://www.youtube.com/watch?v=KeaeuUcw02Q**

Mechanical Engineering Third Year

Course Code	AME0511	L	T	P	Credit
Course Title	Internal Combustion Engine	3	0	0	3

Course objective: This course is designed to make the students familiar with the classification of air standard cycles and efficiencies, thermodynamic analysis, classification of engines, understand the concept Petrol and Diesel engines, Combustion chamber, Engine cooling lubrication, Testing and performance, fuels for SI and CI engine, Crankcase ventilation, modern technologies in I C Engines.

Pre-requisites: basic laws of thermodynamics, Thermodynamic cycles.

Course Contents / Syllabus

Unit-I — **10 Hours**

Construction and Operation: Engine Classification, Constructional Details of Spark Ignition (SI) and Compression Ignition (CI) Engines.

Air Standard Cycles- Otto, Diesel and Dual. Working Principle of Two Stroke SI and CI Engines – Construction and Working. Comparison of SI and CI Engines, Four Stroke and Two Stroke Engines –Scavenging Process, Scavenging Pump, Firing Order, theoretical and actual valve timing diagrams for engines.

Engine Cycles: theoretical Otto, diesel and dual cycles, Fuel-air Cycles and Actual cycle, numerical problems.

Unit-II — **09 Hours**

Construction of engine parts: Cylinder, cylinder head, piston, piston pin, connecting rod, crank shaft, inlet and exhaust valves, flywheel, valve operating mechanisms**,**

Combustion of Fuel: Chemical Composition and Molecular Structure of Hydrocarbon Fuels. Combustion Stoichiometry of Hydrocarbon Fuels – Chemical Energy and Heat of Reaction Calculations – Chemical Equilibrium and Adiabatic Flame Temperature Calculation. Theory of SI and CI Engine Combustion – Flame Velocity and Area of Flame Front. Fuel Spray Characteristics – Droplet Size, Depth of Penetration and Atomization.

Unit-III — **09 Hours**

Combustion in IC Engine: Introduction to Combustion in SI and CI Engines and Stages of Combustion– Ignition Systems. Dependence of Ignition Timing on Load and Speed. Knock in SI and CI Engines.

Combustion Chambers: SI and CI Engines combustion chamber, Direct and Indirect Injection Combustion Chambers for CI Engines. Importance of Swirl– Squish and Turbulence-Measurements. Factors Controlling Combustion Chamber Design– Introduction to Heat Release Measurements.

Unit-IV — **10 Hours**

Cooling System: Necessity, variation of gas temperature, Areas of heat flow, heat transfer, piston and cylinder temperature, Heat rejected to coolant, quantity of water required, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators – types, cooling fan – power requirement, antifreeze solution, types of coolant.

Lubrication System: Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, additives and lubricity improvers, concept of adiabatic engines, oil filters, pumps, and crankcase ventilation – types.

Unit-V — **10 Hours**

Engine Testing: Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Heat Balance, Engine performance maps, Engine testing standards.

Modern Technologies in I C Engines

Stratified-charged Engine, Mixed-cycle engines, HCCI Engines, CRDi injection system, GDI Technology, E-Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology, Hydrogen and Fuel Cell Technology.

New developments in combustion engines. Hybrid powertrain concepts and designs (series, parallel), downsizing, electric powertrain efficiency and control concepts.

Course outcome:

CO 1	To understand need, constructional details and working of various auxiliary system used for internal combustion engine, scavenging systems for two stroke engines.	**K1, K2**
CO 2	To understand available energy sources for internal combustion engine& Determine correct A/F ratio for a given fuel.	**K2,K3**
CO 3	To Illustrate the stages of combustion and its influence by different combustion chamber parameters	**K2,K3**
CO 4	To choose cooling and lubrication system for internal combustion engine	**K2,K3**
CO 5	To explain, classify and analyze various types of modern technologies in IC Engines	**K2,K4**

Text books :

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers

Reference Books:

1. I.C Engine, by R. Yadav, Central Publishing House, Allahabad .
2. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia.
3. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill Pub.
4. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Eductaion

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://extrudesign.com/category/mechanical-engineering/internal-combustion-engines/ .https://www.mechanicalbooster.com/2017/12/valve-timing-diagram-two-stroke-and-four-stroke-engine.html
Unit 2	https://www.youtube.com/watch?reload=9&v=RM0A1kQuXI4 https://www.youtube.com/watch?v=aaopC0Dftbo
Unit 3	https://www.youtube.com/watch?v=UKs4t8yCRyA .https://www.youtube.com/watch?v=YTruI3IVpUI
Unit 4	https://www.youtube.com/watch?v=saJgOYoevP0 https://www.youtube.com/watch?v=8KLNPCT9uLY
Unit 5	https://www.youtube.com/watch?v=tzJd8aHj-vg https://www.youtube.com/watch?v=ZQUO0Jrz8zs

Mechanical Engineering Third Year

Course Code	AME0513	L	T	P	Credit
Course Title	Power Plant Engineering	3	0	0	3

Course objective: To help engineering students understand the concepts and practical aspects of the Design, Construction, Operation, and Energy Conversion of different power plans.

Pre-requisites: The knowledge of the following subjects is essential to understand Power Plant Engineering:

- Thermal Engineering
- Heat Transfer.
- Fluid Mechanics & Hydraulic Machines

Course Contents / Syllabus

UNIT-I | **Introduction, energy scenario and basic concepts** | **8 Hrs**

Scenario and power generation technologies, Statutory and regulatory aspects, and fire protection system, cycle efficiency vs number heaters, understanding of plant performance, Brayton cycle or Joule cycle, Power plant performance measurement.

Coal Based Power Plant: Introduction, Subcritical and Supercritical power plants, Basic Design and Performance parameters, Plant Layout: Turbine, Generator, and Building layout, Site selection: Natural Resources, Economic Factors, Environmental factor, etc. Plant Layout of Thermal Power plant, Coal Based Thermal power plant virtual plant tour.

Steam Generator and its auxiliaries: Steam generator, Fluidized Bed Combustion Boiler, Circulation system in Subcritical Steam generator, Efficiency of the Steam generator, Air & Draft system, Coal Milling System, Flue Gas Desulphurization (FGD): Overview and types of FGD systems, Selection Catalytic reduction (SCR-SNCR): NOx, reduction technique, Overview of Electrostatic Precipitator and bag filter, Principle of operation of ESP.

UNIT-II | **Power Plant Steam Turbine and auxiliary systems** | **8 Hrs**

Steam turbine auxiliary systems, ST Auxiliary Systems: Electrohydraulic oil system, Gland Steam systems, Lube Oil Purification System, Condensate system and its major equipment

Material Handling System

Technologies and material handling system, *Fuel handling systems:* Type of fuel oil and typical characteristics, Safety aspects in the fuel oil system, Coal handling plant system design, *Ash Handling system:* Type of ash handling systems, Ash utilization, Overview of Limestone, and gypsum handling system.

Power Plant Water, Compressed Air System, and Fire system

Raw water intake system: water source and selection criteria, Water chemistry and its significance: Water use and analysis, Chemical dosing and filtration, Demineralization plant (DM) plant: ION Exchange, Condensate Polishing unit, Steam, and water analysis system (SWAS)

UNIT-III | **Gas Based power plant** | **6 Hrs**

Introduction and advantages of a Gas based power plant, Heat Recovery Steam Generator, Major gas turbine auxiliary systems: Intake filter, Lube and Jacking Oil System, Natural Gas System, Heat Recovery steam generator system (HRSG): Function of HRSG in combined cycle power plant, Overview of Gas based plant layout, Layout of an open cycle and combine cycle power plant

Nuclear Power Plant

Introduction to Nuclear power plant, Power Reactor, Safety of Nuclear Power Reactor-Safety measures, Fuel and water system, Waste disposal and Site selection, Thermodynamic cycle of a nuclear power plant.

UNIT-IV | **Renewable Energy (RE) Sources** | **10 Hrs**

Importance, Role, and Potential of renewable sources of energy, Sustainable Types of RE sources, Limitations of RE sources,

Wind energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics,

Solar energy

Solar energy an option, Environmental impact of solar power, physics of the sun, the solar constant, instruments for measuring solar radiation.

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation, and thermal analysis.

Solar Energy Storage and Applications: Different methods, Sensible, latent heat, and stratified storage, solar ponds. Solar Applications solar heating/cooling technique, solar distillation, and drying, photovoltaic energy conversion

Biomass energy

Principles of Bioconversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine.

Other energy sources: Tidal Energy, Wave Energy, Ocean Thermal Energy Conversion (OTEC), Hydrogen Production and Storage, Fuel cell,

UNIT-V	**Basics of Power Plant Piping, Physical layout, and development**	**10 Hrs**

Introduction to power plant piping and piping components, Basics of power station valve, Comparison of features of generic types of valves, Multidisciplinary activities, *Introduction to Industrial drawing:* Piping and instrumentation diagram, pipe stress analysis, Pipe supports,

Overview of Electrical Generator and its Auxiliary Systems

Basics of Generator and Types of Generators, Generator testing, Excitation, and synchronization, H_2 and CO_2 Gas system, Stator coil cooling water system

Overview of Electrical system for power plant

Electrical system-Introduction and plant Auxiliary distribution system, Main, Auxiliary, and Evacuation power system, Electrical power system studies, Electrical Power Evacuation System, Cable, Raceway, Earthing, and Lightning

Power Plant Measuring Instruments

Instruments: Introduction and selection criterion, Supervisory instruments and analyzers used in Power plant, Control valve construction and CV sizing, Control valve actuator types, Cavitation, and flashing

Power Plant Control System

Overview, Automated Control system, Control system configuration, Wireless Communication, Foundation Fieldbus and Profibus in power plant.

Course outcome:

CO 1	To understand the need, importance, and energy scenario in coal-based power plants.	K1, K2
CO 2	To understand the role of steam turbine power plant auxiliary systems and material handling and water balance diagram.	K2, K3
CO 3	To ascertain fundamental design parameters (including thermodynamic cycles) of gas-based power plants and nuclear power plants.	K2, K4
CO 4	To understand the need and process of extracting electrical energy from renewable energy sources.	K3, K4
CO 5	To understand, identify and design the power plant piping and components, an overview of electrical systems for power plant and power plan measuring and controlling systems.	K4, K5

Text books :

1. Power Plant Engineering 4th Edition, By P K Nag,
2. A Course in Power Plant Engineering: / Arora and S. Domkundwar.
3. Power Plant Engineering – P.C. Sharma / S.K. Kataria Publication.

Reference Books:

1. Fundamentals and Applications of Renewable Energy by Mehmet Kanoglu, Yunus A. Cengel
2. Power Plant Engineering, F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras
3. Power Plant Technology El-Vakil, McGraw Hill

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://www.youtube.com/watch?v=O8zMD1eCbq0 https://www.youtube.com/watch?v=BXbRJ0OB9A0
Unit 2	https://www.youtube.com/watch?v=Jb-ZDmjxdwM https://www.youtube.com/watch?v=8uwrMLrqQlU
Unit 3	https://nptel.ac.in/courses/103103206
Unit 4	https://www.youtube.com/watch?v=UW4HYJ36q0Y https://www.youtube.com/watch?v=sh4ZjiVlRC4 https://nptel.ac.in/courses/103103206
Unit 5	https://www.youtube.com/watch?v=9njuNoLIADY https://www.youtube.com/watch?v=YYKOS1F-iGo

Mechanical Engineering Third Year

Course Code	AME0512	L	T	P	Credit
Course Title	Mechatronics Systems	3	0	0	3

Course objective

1	Understand key elements of Mechatronics system and its integration in manufacturing system.
2	Impart the knowledge of different sensors and transducers used in manufacturing system.
3	Impart the knowledge of various actuation systems and controllers used in manufacturing system.
4	Familiarize concepts of microprocessors, microcontrollers, and PLC.
5	Apply interdisciplinary knowledge of mechanical and electronic components in manufacturing system.

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Pre-requisites: Students know about basics of electronics.

Course Contents / Syllabus

UNIT-I	Introduction to Mechatronics System	8 hours

Introduction:

Introduction to Mechatronics: Function of Mechatronic System, Scope &Application of Mechatronics, Advantages and disadvantages of Mechatronics, role of mechatronics in manufacturing. Production line automation, Benefit of Mechatronics in Manufacturing. Representation of Mechatronic System in block Diagram and Concept of transfer function for each element of Mechatronic system. Basic concept of Robotics, Autotronics, Bionics, and Avionics and their applications

UNIT-II	Signal Transmission Sensors and transducers	10 hours

Signal transmission: types of signals:- hydraulic signal, pneumatic signal, electronics signal. ADC (Analog to Digital Convertor, DAC (Digital to Analog Convertor) R-2R circuit and DAC resolution. Signal Filters: Low pass, High Pass and Band Pass with circuit diagrams for simple cases

Sensors and transducers: Sensors & Transducer with classification, Development in Transducer technology, Criteria for selection of sensors based on requirements, Principle of measurement, Sensing method, Performance chart etc. (Displacement, temperature, acceleration, force/pressure) based on Static and Dynamic characteristics. Principle of working and application of Inductive Proximity, Capacitive Proximity, Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors

UNIT-III	Actuators and Actuation system	8 hours

Actuators: Types of Actuators, Selection of Actuators based on principle of operation, Performance characteristics, Maximum loading conditions, Safety etc., Principle and Selection of Mechano-electrical actuators, Micro actuators.

Electrical Actuation Systems: Introduction to Switching devices, Concept of Electromechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3 Phase Induction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNIT-IV	Hydraulic & Pneumatic Actuation System	10 hours

Hydraulic Actuation System: Different types of valves such as flow, Direction control valve, Hydraulic pumps, Actuators and Auxiliary elements in Hydraulics, their applications and use of their Graphical Symbols, Synthesis and design of circuits (up to 2 cylinders), Hydraulic system design, Electro-Hydraulics.

Pneumatic Actuation System: Production and Distribution of Compressed air, Components of Pneumatic System, Different types of Valves, Graphical symbols, Graphical representation and design of Pneumatic system , Electro- Pneumatics

UNIT-V	Control System & Programming Techniques	10 hours

Control System: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

Programmable Logic Devices, Introduction to PLC, selection of PLC, Architecture, Latching, Timers, Counter.

Automatic Control and Real Time Control Systems; types of controllers, PID controller, adaptive control, P, PI, PD and PID control systems

Programming Techniques: Ladder Logic programming for different types of logic gates, Ladder diagram – Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers, and Counter

Course outcome:

CO1	Identify mechatronic system and have knowledge about the sensors and transducers used in manufacturing system.	K2
CO2	Identify different actuation systems and design basic system for manufacturing system.	K2,K3
CO3	Design and apply hydraulic, pneumatic and electrical system in manufacturing.	K3,K4
CO4	Identify different types of controllers and ability to choose one according to the need.	K2
CO5	Design a mechatronic system for manufacturing.	K4

Text books :

1	Mechatronics System Design , Shetty and Kolk, Cengage Learning, India Edition
2	Introduction to Mechatronics and Measurement Systems, Alciatore and Hist and Tata McGraw-Hill
3	Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton Pearson education

Reference Books:

Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education

A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited

Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://www.youtube.com/watch?v=4lilX8cHDHI.
Unit 2	https://www.youtube.com/watch?v=1uPTyjxZzyo.
Unit 3	https://www.youtube.com/watch?v=YBpfLWTE6ak.
Unit 4	https://www.youtube.com/watch?v=akZjDHD6JC4
Unit 5	https://www.youtube.com/watch?v=6Ro3lnNYU2w

Mechanical Engineering Third Year

Course Code	AME0514	L	T	P	Credit
Course Title	Computer Aided Engineering	3	0	0	3

Course objective:

1	Understand the importance, benefits, applications and essential elements of CAD such as graphics input, display and output devices.	K_1, K_2, K_3
2	Impart the fundamentals approach for generating line, circle by algorithm and understand the mathematics behind 2D & 3D geometric transformations.	K_2, K_3
3	Develop the mathematical representation of parametric form of analytic planar curves and synthetic space to create and manipulate the design using various types of curves	K_2, K_3
4	Impart the fundamentals of CAD tools to create and manipulate the design conceptualization, geometric modelling using surfaces and solids.	K_2, K_3, K_4
5	Understand the fundamental concepts of Finite Element method and different approaches used to solve realistic problems in Mechanical Engineering	K_2, K_3

Pre-requisites: Students should have basic knowledge of computer, Engineering Drawing, and manufacturing process.

Course Contents / Syllabus

UNIT-I **Introduction:** **8 Hours**

Computer in Engineering Design, Classical vs Computer Aided Design, Elements of CAD, Essential requirements of CAD, CAD Tools, Concepts of integrated CAD/CAM, Necessity & Benefits, Engineering Applications.

Computer Graphics Hardware:

Graphics systems, Graphics Input devices – Cursor control devices, Digitizers, Image scanner, Keyboard terminals, Speech oriented devices, Graphics display devices – Cathode Ray Tube, Random & Raster scan display, Direct View Storage Tubes, Color CRT monitors, Solid state monitors – emissive displays and non-emissive displays, Graphics output devices – Hard copy printers and plotters.

UNIT-II **Computer Graphics Software:** **12 Hours**

Graphics Software, Software Configuration, Graphics Functions, Graphics standards, viewing transformations – windowing and clipping.

Output primitives:

Line generation algorithms – DDA and Bresenham's line drawing algorithm, Circle generating algorithm – Mid-point and Bresenham's algorithm.

Geometric Transformations:

2D Geometric transformations – Translation, Scaling, Shearing, Rotation & Reflection matrix representation, Rotation and scaling about arbitrary point, Reflection through arbitrary line, Composite transformation, 3D transformations, Multiple transformation.

UNIT-III **Planar Curves:** **8 Hours**

Curves representation, Properties of curve design, Interpolation vs Approximation, Parametric representation of analytic curves, Parametric continuity conditions,

Space Curves:

Parametric representation of synthetic curves – Spline curves and specifications, Hermite curves – Blending function formulation and its properties, Bezier curves – Blending function formulation and its properties, B-spline curves – Blending function formulation and its properties.

UNIT-IV **3D Graphics:** **6 Hours**

Introduction, Wireframe modelling, Surface modelling, Polygon surfaces – Polygon meshes, Polygon equations, Quadric and Super quadric surfaces, Blobby objects, Solid modelling – Solid entities, Boolean set operations, Sweep representation – Translational, Rotational and Hybrid sweeps, Boundary representation – Topology, Geometry, Boundary models, Constructive solid geometry – Unbounded and Bounded primitives.

Color models:

Coloring in computer graphics, RGB, CMY, YIQ, HSV and HLS color models

UNIT-V **Finite Element Modelling:** **8 Hours**

Introduction, Principles of Finite elements modelling, General procedure for finite element analysis, Local and global coordinates, node and elements, Mesh Generation and its requirements Stiffness matrix/displacement matrix, Formulation of global stiffness matrix, Weighted Residual methods, Variation Rayleigh Ritz method, Principle of minimum potential energy. Problem on spring system, bar & beam elements.
Commercially available FEM packages, Desirable features of FEM packages, An overview of FEM software's like ANSYS, ABAQUS, NISA etc.

Course outcome:

CO1	Understand the knowledge of basic structure of CAD, Memory types, input/output devices, display devices and its working principles.	K_1, K_2, K_3
CO2	Develop about the knowledge of graphics software, graphics standards, configuration, and functions; skill of writing algorithm for generating 2D graphic elements; and apply the mathematics behind 2D & 3D individual and combined geometric transformations.	K_2, K_3
CO3	The ability of mathematical representation of parametric form of analytic planar curves and synthetic space curves such as Hermite, Bezier and B-spline curves and knowledge of their properties.	K_2, K_3
CO4	The ability the knowledge of polygonal, quadric and super quadric surfaces, blobby objects, color models, and different solid modelling techniques and the skill of developing 3D geometric models in CAD software.	K_2, K_3, K_4
CO5	Apply the fundamental concepts and approaches to solve a realistic engineering problem and analyze the design using Finite Element Methods.	K_2, K_3

Text books :

1. Computer Graphics-Hearn & Baker (Prentice Hall of India)
2. CAD/CAM Theory and Practice- Ibrahim Zeid & R Sivasubramaniam (McGraw Hill)
3. CAD/CAM-HP Groover & EW Zimmers, Jr (Prentice Hall India)

Reference Books:

1. Computer Aided Engineering Design-Anupam Saxena & B. Sahay (Anamaya Publishers)
2. Mathematical Elements for Computer Graphics- DF Rogers & JA Adams (McGraw Hill)
3. Computer Aided Design-S.K. Srivastava (IK International Publications)
4. Computer Aided Design-R.K. Srivastava (Umesh Publications)
5. The Finite Element Method in Engineering by S. S. Rao, (Pergamon Press, Oxford)
6. An Introduction to Finite Element Method by J.N. Reddy published (Mc Graw Hill)

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://youtu.be/EgKc9L7cbKc https://youtu.be/1y2Vec5XdXg https://youtu.be/HJLuKbU11jY https://youtu.be/BgGADYtIhgk https://youtu.be/082HkPVEz_8 https://youtu.be/6XTLrz9Wd9E https://youtu.be/l95BztHFk5g
Unit 2	https://youtu.be/MViI7GPG9xo https://youtu.be/qrWASTbyyBQ https://youtu.be/iWxS2zpaRjk https://youtu.be/I8o4kK9QRL4 https://youtu.be/yZIyWA08sJ4 https://youtu.be/QIa-V7XuJEM
Unit 3	https://youtu.be/0NbD-c0Ctdk https://youtu.be/uKXbkJR6gek

	https://youtu.be/sxvcjmbolXw https://youtu.be/mEAmuKxYPLQ https://youtu.be/FTg1DUr7bhY https://youtu.be/2-V4oHj0xpY https://youtu.be/7yc4Pf14FIw https://youtu.be/1foc4sbmQb8
Unit 4	https://youtu.be/TEAtmCYYKZA https://youtu.be/Sp0OogV-Eh0 https://youtu.be/FshEXrd28qw https://youtu.be/TYqzwU8pW7s https://youtu.be/HaVAANeXb0A
Unit 5	https://youtu.be/GHjopp47vvQ https://youtu.be/hVleTL6CeKw https://youtu.be/boSLQYhDXoE https://youtu.be/GVBv2Yz4n2c https://youtu.be/lH1vgdJwlDQ.

Mechanical Engineering Third Year

Course Code	AME0551	L	T	P	Credit
Course Title	**Heat and Mass Transfer lab**	0	0	2	1

Course objective: Students will be perform the experiments based on conduction convection and heat exchanger.

Pre-requisites: Student know the concept of conduction convection and heat exchangers.

Course Contents / Syllabus

Suggested list of Experiment

Perform Ten experiment from the list of Experiment

Sr. No.	Name of Experiment
1	Conduction – Experiment on Composite plane wall
2	Conduction - Experiment on critical insulation thickness
3	Conduction – Experiment on Thermal Contact Resistance
4	Convection - Pool Boiling experiment
5	Convection - Experiment on heat transfer from tube- (natural convection).
6	Convection - Heat Pipe experiment.
7	Convection - Heat transfer through fin- (natural convection).
8	Convection - Heat transfer through tube/fin- (forced convection).
9	Convection - Determination of thermal conductivity of fluid
10	Experiment on Stefan's Law, on radiation determination of emissivity, etc.
11	Experiment on solar collector, etc.
12	Heat exchanger - Parallel / Counter flow experiment
13	Making of Thermocouple
14	Calibration of thermocouple.

Course outcome:

CO 1	Formulate heat conduction problems to determine the conductivity of composite material	K3
CO 2	Analyze the heat transfer through extended surface, calculate the temperature distribution, effectiveness for pin fin.	K3
CO 3	Analyze the phenomena of boiling and condensation.	K3
CO4	Modelling of Heat exchanger problem to Calculate fluid temperature, heat exchange and effectiveness during parallel and counter flow heat exchanger.	K3
CO 5	Calculate the Stefan Boltzmann's Constant and measure emissivity of different surfaces.	K3

Link: NPTEL/ YouTube/ Faculty Video Link:

1.	http://htv-au.vlabs.ac.in/
2.	http://vlabs.iitb.ac.in/vlab/chemical/List%20of%20experiments.html?domain=Chemical%20Engineering

Mechanical Engineering Third Year					
Course Code	**AME0552**	**L**	**T**	**P**	**Credit**
Course Title	**THEORY OF MACHINES**	**0**	**0**	**2**	**1**

Student will perform the experiments based on mechanism, governor, gear train and vibration.

Pre-requisites: Studnets know the theory of mechanism , governor and vibrations

Course Contents / Syllabus

Sr. No.	Name of Experiment
1	Study of simple linkage models/mechanisms
2	Study of inversions of four bar linkage
3	Study of inversions of single/double slider crank mechanisms
4	Experiment on critical speed of shaft
5	Experiment on cam and follower motion
6	Experiment on gyroscope
7	Experiment on static/dynamic balancing
8	Experiment on watt governor
9	Experiment on porter governor
10	Experiment on proell governor
11	Experiment on hartnell governor
12	Experiment on gear trains
13	Experiment on longitudinal vibration
14	Experiment on transverse vibration

Lab Course Outcome:

CO 1	Student will be able to understand the relative motion between the element of a mechanisms and their inversion for the specified type of motion in a machine.
CO 2	Student will be able to understand the fundamental principles of balancing to balance the masses statically & dynamically of a rotating mass system and observe the effect of unbalance in a rotating mass system.
CO 3	Student will be able to demonstrate the torque analysis and measure epicyclic gear ratio on any kind of on engine or machine shaft.
CO 4	Student will be able to understand the working principle of a governor and able to identify different types of governors in actual practice for maintain the constant speed of engine.
CO 5	Student will be able to understand the fundamental principles of gyroscope and observe the gyroscopic effect of a rotating disc.
CO 6	Student will be able to observe the effect of longitudinal, transverse and torsional vibration and determine the frequency and time period of oscillation.

Link:

Unit 1	https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
Unit 2	https://www.youtube.com/watch?v=55tKVBVQDUY
Unit 3	https://www.youtube.com/playlist?list=PL46AAEDA6ABAFCA78
Unit 4	https://www.youtube.com/watch?v=OlZXxPVpmBs
Unit 5	https://www.youtube.com/watch?v=ZldkigrDplc

Mechanical Engineering Third Year					
Course Code	**AME0553**	**L**	**T**	**P**	**Credit**
Course Title	**Applied Industrial IOT lab**	**0**	**0**	**2**	**1**
Course objective: Student will perform the study on sensor and instrumentation, actuator systems and perform the experiment on IOT based systems.					
Pre-requisites: Students know about the sensors and actuation system and IOT based systems**.**					
Course Contents / Syllabus					
S. No.	**LIST OF EXPERIMENTS** (Total Eight to be performed)				
1	Study of Sensing and Actuating systems used in Industrial IOT.				
2	Study of Healthcare based sensors such as:- ECG – Electrocardiogram ACC – Accelerometer, TEMP – Temperature, RESP – Respiration, Heartbeat sensor.				
3	Study of Agriculture based sensors such as:- Temperature, Humidity, Pressure Sensor, Soil Temperature, Soil Moisture, Rain sensor.				
4	Study of Healthy Environment based sensors such as:- PIR Motion sensor. Air quality sensor, Fire sensor, Accelerometer, Gyroscope sensor, Gas sensors, Light sensors.				
5	Introduction to IoT, Arduino platform and perform necessary software installation.				
6	To interface motor using relay with Arduino and write a program to turn motor ON/OFF.				
7	To interface sensors to Arduino and display the sensor data.				
8	To interface sensor with Arduino and write a program to turn ON/OFF Solenoid valve when sensor data is detected.				
9	To interface sensor with Arduino and write a program to turn ON/OFF Linear Actuator when sensor data is detected.				
10	To interface Arduino to a Bluetooth Module and send sensor data to a smart phone using Bluetooth.				
11	Develop an IoT based Smart water flow system.				
12	Develop an IoT based smart lock system for Motor cycle/Car/Household door				
Course outcomes: After completion of this course students will be able to					
CO 1	Become familiar with the concept of Sensor systems				
CO 2	Understand and implement fundamentals of IOT				
CO 3	Practically implement the concepts IOT programming				
CO 4	Learn and implement the concepts Industrial IOT				
Link: NPTEL/ YouTube/ Faculty Video Link:					
Link 1	Difference between Sensor and Actuator - GeeksforGeeks				
Link 2	Temperature Sensors: Types, How It Works, & Applications (encardio.com)				
Link 3	https://www.fierceelectronics.com/sensors/what-accelerometer				

B. TECH. THIRD YEAR			
Course Code	**ANC0501**	**L T P**	**Credits**
Course Title	**CONSTITUTION OF INDIA, LAW AND ENGINEERING**	**2 0 0**	**2**

Course objective: To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.

Pre-requisites: Computer Organization and Architecture

Course Contents / Syllabus

UNIT-I	**INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION**	**8 Hours**

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

UNIT-II	**UNION EXECUTIVE AND STATE EXECUTIVE**	**8 Hours**

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of Vice-President, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

UNIT-III	**INTRODUCTION AND BASIC INFORMATION ABOUT LEGAL SYSTEM**	**8 Hours**

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

UNIT-IV	**INTELLECTUAL PROPERTY LAWS AND REGULATION TO INFORMATION**	**8 Hours**

Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information, Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

UNIT-V	**BUSINESS ORGANIZATIONS AND E-GOVERNANCE**	**8 Hours**

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company,

Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

COURSE OUTCOMES: After completion of this course students will be able to

CO 1	Identify and explore the basic features and modalities about Indian constitution.	K1
CO 2	Differentiate and relate the functioning of Indian parliamentary system at the center and state level.	K2
CO 3	Differentiate different aspects of Indian Legal System and its related bodies.	K4
CO 4	Discover and apply different laws and regulations related to engineering practices.	K4
CO 5	Correlate role of engineers with different organizations and governance models	K4

Text Books:

1. M Laxmikanth: Indian Polity for civil services and other State Examination,6th Edition, Mc Graw Hill
2. Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.
3. Granville Austin: The Indian Constitution: Cornerstone of a Nation (Classic Reissue), Oxford University Press.

Reference Books:

1. Madhav Khosla: The Indian Constitution, Oxford University Press.
2. PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
3. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)

B. TECH. THIRD YEAR

Course Code	ANC0502	L T P	Credits
Course Title	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2 0 0	2

Course objective: This course aims to provide basic knowledge about different theories of society, state and polity in India, Indian literature, culture, Indian religion, philosophy, science, management, cultural heritage and different arts in India.s

Pre-requisites: Computer Organization and Architecture

Course Contents / Syllabus

UNIT-I	SOCIETY STATE AND POLITY IN INDIA	8 Hours

State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women.

UNIT-II	INDIAN LITERATURE, CULTURE, TRADITION, AND PRACTICES	8 Hours

Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali,Prakrit And Sanskrit, Sikh Literature, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature,Malayalam Literature ,Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature

UNIT-III	INDIAN RELIGION, PHILOSOPHY, AND PRACTICES	8 Hours

Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.

UNIT-IV	SCIENCE, MANAGEMENT AND INDIAN KNOWLEDGE SYSTEM	8 Hours

Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India , Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times.

UNIT-V	CULTURAL HERITAGE AND PERFORMING ARTS	8 Hours

Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Pottery, Painting, Indian Handicraft, UNESCO'S List of World Heritage sites in India, Seals, coins, Puppetry, Dance, Music, Theatre, drama, Martial Arts Traditions, Fairs and Festivals, UNESCO'S List of Intangible Cultural Heritage, Calenders, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema.

COURSE OUTCOMES: After completion of this course students will be able to

CO 1	Understand the basics of past Indian politics and state polity.	K2
CO 2	Understand the Vedas, Upanishads, languages & literature of Indian society.	K2
CO 3	Know the different religions and religious movements in India.	K4

CO 4	Identify and explore the basic knowledge about the ancient history of Indian agriculture, science & technology, and ayurveda.	K4
CO 5	Identify Indian dances, fairs & festivals, and cinema.	K1

Text Books:

1. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
2. S. Baliyan, Indian Art and Culture, Oxford University Press, India
3. Nitin Singhania, Indian Art and Culture: for civil services and other competitive Examinations,3rd Edition,Mc Graw Hill

Reference Books:

1. Romila Thapar, Readings In Early Indian History Oxford University Press, India
2. Basham, A.L., The Wonder that was India (34th impression), New Delhi, Rupa & co.

BTECH THIRD YEAR

Course Code	AME0601	L-T-P	Credit
Course Title	Design of Machine Elements	3-1-0	4

Course objective:

1.	To develop an Efficient, Economic and Ecofriendly product for the welfare of society based on market demand.	K1,K2
2.	To develop sustainable approach in problem solving for the society.	K2,K3
3.	To develop an art of design & analysis the complex problem related to machine elements.	K3,K4,K5

Pre-requisites:

- General laws of science, force analysis.
- Basic knowledge of material science & manufacturing.
- Fundamental of engineering mechanics & Strength of Material.

Course Contents / Syllabus

UNIT-I	INTRODUCTION & DESIGN FOR STATIC LOAD	8 hours

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Indian Standards designation of carbon & alloy steels Selection of preferred sizes, Selection of materials for static and fatigue loads.

Design for Static Load

Stresses due to bending and torsion, Theory of failure, Cause of failure in shafts, Materials for shaft, Design of shafts subjected to twisting moment, bending moment and combined twisting & bending moments, ASME design, Shafts subjected to fatigue loads, Design for rigidity.

UNIT-II	DESIGN FOR FLUCTUATING LOAD & MECHANICAL SPRING	10 hours

Design for Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor and its measures for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Mechanical Springs

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.

UNIT-III	SPUR GEAR & HELICAL GEAR	12 hours

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth.

Helical Gears

Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength & wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

UNIT-IV	BEVEL GEAR & WORM GEAR	12 hours

Bevel gears

Terminology of bevel gears, Force analysis, Virtual number of teeth, Beam strength and wear strength of bevel gears, Effective load of gear tooth, Design of a bevel gear system.

Worm Gears

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system.

UNIT-V	**SLIDING & ROLLING CONTACT BEARING**	**10 hours**

Sliding Contact Bearing

Types, Properties and materials, Hydrodynamic lubrication, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing

Rolling Contact Bearing

Types, Advantages and disadvantages, Designation of bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Design of roller bearing.

Course outcome: After completion of this course students will be able to

CO1	Analyse stress in different components, theories of failure and material science to analyse, design and/or select commonly used machine components.	K1, K2
CO2	Analyse fluctuating stress in different components using different criterion.	K1, K2, K3
CO3	Design Spur and helical gear for different application.	K1, K2, K3, K4, K5
CO4	Design Bevel and Worm gear for different application.	K1, K2, K3,
CO5	Select the suitable bearing for given operating conditions.	K1, K2, K3,K4

Text books

1. Text Book of Machine Design, R. S. Khurmi, Eurasia Publishing House.
2. A Text Book of Machine Design, Dr. Rajendra Karwa, Laxmi Publications.
3. Design of Machine Elements, V. B. Bhandari, Tata McGraw Hill Co.
4. Machine Design: An Integrated Approach, Robert L. Norton, Pearson Education
5. Design of Machine Elements: Volume II, T. Krishna Rao, I K International Publishing House Pvt. Ltd
6. Mechanical Engineering Design, Joseph Shigley, McGraw-Hill Education

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1 https://youtu.be/ofmbhbVCUqI
https://youtu.be/m9l1tVXyFp8

Unit 2 https://youtu.be/2xLHFiBOA4M
https://youtu.be/QfhIea6KzZA

Unit 3 https://youtu.be/46quOD7V-cQ
https://youtu.be/i9xbJTIGJlE

Unit 4 https://youtu.be/0jNX9bnWkho
https://youtu.be/kBLWugfEjrs

Unit 5 https://youtu.be/NZOKgk001_E
https://youtu.be/ZCvOjnRi9TM
https://youtu.be/rB3qIBSEI4A

Bachelor of Technology Third Year					
Course Code	**AME0603**	**L**	**T**	**P**	**CREDITS**
Course Title	**INDUSTRIAL ENGINEERING**	3	0	0	3

Course objective: To make the students able

1	To understand the Concept of Industrial engineering.	K_2
2	Understand the forecasting and scheduling techniques.	K_3, K_4
3	To understand the concept of inventory control and queuing theory	K_3, K_4
4	To apply the concept of work system design	K_3, k_4
5	Ability to solve the problem of LPP, Transportation.	K_3, K_4

Pre-requisites: Basic knowledge of production system

Course Contents / Syllabus

UNIT-I	Overview of Industrial Engineering	9 hours

Overview of Industrial Engineering: Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

UNIT-II	Production Planning and Control	9 hours

Production Planning and control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

Project Management: Project network analysis, CPM, PERT and Project crashing.

UNIT-III	Engineering Economy and Inventory Control	10 hours

Engineering economy and Inventory control: Methods of depreciation; break even analysis, techniques for evaluation of capital investments, financial statements, time cost tradeoff, resource leveling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

UNIT-IV	Work System Design	9 hours

Work System Design: Taylor's scientific management, Gilbreth's contributions; work study: method study, micro motion study, principles of motion economy; work measurement –time study, work sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Product Design and Development: Principles of product design, tolerance design; quality and cost Considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

UNIT-V	Operational Analysis	9 hours

Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy, and unbound solutions. Transportation and assignment models; Optimality test: the steppingstone method and MODI method, simulation.

Course outcome:	**After completion of this course students will be able to**	
CO 1	Understand the concept of production system, productivity, facility and process planning in various industries	**K2**
CO 2	Apply the various forecasting and project management techniques	**K3**
CO 3	Apply the concept of breakeven analysis, inventory control and resource utilization using queuing theory	**K3**
CO 4	Apply principles of work study and ergonomics for design of work systems	**K3**
CO 5	Formulate mathematical models for optimal solution of industrial problems using linear programming approach	**K4**

Text books:

1. Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
2. Industrial Engineering and Production Management by M. MahajanDhanpatRai& Co. (P) Limited

Reference Books:

1. Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
2. Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI
3. Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI
4. Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
5. Production Systems Analysis and Control by J.L.Riggs, John Wiley & Sons
6. Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
7. Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
8. Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://archive.nptel.ac.in/courses/112/107/112107143/
Unit 2	https://nptel.ac.in/courses/112107143
Unit 3	https://www.youtube.com/watch?v=ZpUD9kkPTiI https://www.youtube.com/watch?v=xGkpXk-AnWU
Unit 4	https://nptel.ac.in/courses/112107142 https://onlinecourses.nptel.ac.in/noc21_me83/preview
Unit 5	https://nptel.ac.in/courses/111102012

B TECH THIRD YEAR			
Course Code	**AME0602**	**L-T-P**	**Credit**
Course title	**REFRIGERATION AND AIR CONDITIONING**	**3-0-0**	**3**
Course objective:			
1	To Learn the fundamental principles and different methods of refrigeration and its application in different aircraft refrigeration systems.	K_1, K_2	
2	To study of different refrigerants with respect to properties, and familiarize the simple and compound vapour compression refrigeration systems.	K_3, K_4	
3	To understand the vapour absorption refrigeration systems and some recent refrigeration systems and its operating principles.	K_2, K_3	
4	To Learn principles of psychrometric processes and load calculations criteria for comfort and different air conditioning systems.	K_3, K_4	
5	To study about different refrigeration Equipments and its application in industry.	K_2, K_3	
Pre-requisites: Thermodynamics, Basic Fluid Mechanics, Heat and Mass Transfer			
Course Contents / Syllabus			
UNIT-I	**Basics of refrigeration and air refrigeration systems**	**8 hours**	
Introduction: Brief history and need of refrigeration and air conditioning, methods of natural refrigeration, unit of refrigeration, coefficient of performance, types and application of refrigeration. **Air refrigeration:** Reversed Carnot cycle and its limitation, Bell-Coleman cycle, aircraft refrigeration, working and analysis of Simple; Bootstrap; Reduced ambient and Regenerative air refrigeration systems, comparison of different aircraft refrigeration systems with Mach number.			
UNIT-II	**Refrigerants and Vapour compression refrigeration.**	**12 hours**	
Refrigerants: Classification, nomenclature, desirable properties, secondary refrigerants, future industrial refrigerants, recent trends in refrigerants and its environmental impact. **Vapour Compression system:** Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle. Compound Compression System: Compound compression with intercooler, flash gas removal and flash intercooler, Multistage vapour compression system requirement, Different configuration of multistage system, cascade refrigeration system.			
UNIT-III	**Absorption and other refrigeration systems**	**10 hours**	
Absorption Refrigeration System: Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems .practical NH3- H2O cycle, LiBr – H_2O system and its working, Electrolux refrigeration system. **Other refrigeration systems:** Thermo-electric refrigeration system, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.			
UNIT-IV	**Air conditioning**	**12 hours**	
Psychrometry: Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass			

factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). **Air conditioning systems and components:** Summer and winter air conditioning system, Air ventilation system, Air Washers, Cooling towers.		
UNIT-V	**Refrigeration Equipments and applications**	**8 hours**
Refrigeration System Equipment: Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans. **Application:** Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Comfort and Industrial air conditioning.		
Course outcome:	**After completion of this course students will be able to**	
CO 1	Illustrate the basic concepts of refrigeration and air conditioning systems and air refrigeration cycles	K_1, K_2
CO 2	Analyze the simple vapour compression refrigeration systems , multi stage vapour compression refrigeration systems and the properties, applications and environmental issues of different refrigerants used in refrigeration and air conditioning,	K_3, K_4
CO 3	Familiarize about the various equipments employed in refrigeration and air conditioning systems and grasp construction and working of vapour absorption system.	K_2, K_3
CO 4	Calculate the heating and cooling load requirements of a room and design it for human and industrial comfort.	K_3, K_4
CO 5	Apply scientific and engineering principles to analyze and design of ducting and ventilation systems that relate to refrigeration and air conditioning.	K_2, K_3
Text books		
1. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.		
2. Refrigeration and Air-conditioning by Ramesh Arora , Prentice Hall of India		
3. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher		
4. Principles of Refrigeration by Roy. J Dossat, Pearson Education		
5. Refrigeration and Air Conditioning by Jordon and Prister, Prentice Hall of India Pvt. Ltd.		
Reference Books		
1. Refrigeration and Air Conditioning by R.S. Khurmi&J.K.Gupta, S.Chand Publication		
Link: NPTEL/ YouTube/ Faculty Video Link:		
Unit 1 https://youtu.be/4mWsRUr0A7A		
Unit 2 https://youtu.be/XO2PBDMEHfs		
Unit 3 https://youtu.be/4w3Obp8ILpA		
Unit 4 https://youtu.be/0BOVDcMxlyY		
Unit 5 https://youtu.be/ExNJoT_2XeI		

BTECH THIRD YEAR			
Course code	**AME0611**	**L-T-P**	**Credit**
Course title	**Hybrid Vehicle Propulsion**	**3-0-0**	**3**
Course objective:			
1.	Understand the basics of the hybrid electric vehicles and it's types.		K2
2.	Understand the types of drive trains used in hybrid vehicles		K2
3.	Understand the propulsion units used in Hybrid Vehicles and their efficiency.		K2
4.	Understand the requirements and devices of energy storage used in hybrid vehicles.		K2
5.	Understand the concept of downsizing of IC engines in case of hybrid vehicles.		K2
6.	Understand the principles of energy management and issues related to these strategies.		K2

Pre-requisites:

Interest in hybrid Vehicles

Course Contents / Syllabus

UNIT-I	**Introduction to Hybrid Electric Vehicles**	**8 hours**

Introduction : History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles:

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT-II	**Hybrid & Electric Drive-trains**	**10 hours**

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains:

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT-III	**Electric Propulsion unit**	**12 hours**

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT-IV	**Energy Storage**	**12 hours**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT-V	**Energy Management Strategies**	**10 hours**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text books

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004

Reference Books

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1 https://nptel.ac.in/courses/108103009

Unit 2 https://youtu.be/WfiTscWVfWI

Unit 3 https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr

Unit 4 https://nptel.ac.in/courses/108106170

Unit 5 https://onlinecourses.nptel.ac.in/noc20_ee99

BTECH THIRD YEAR

Course code	AME0613	L-T-P	Credit
Course title	Vehicle Body Engineering	3-0-0	3

Course objectives:

This course provides a fundamental understanding (A) To present a problem in depth Knowledge of automobile chassis and body engineering (B) To address the underlying concepts and methods behind automobile chassis and body engineering

Pre-requisites:

Interest in electric Vehicles

Course Contents / Syllabus

UNIT-I Classification of Coachwork — 9 hours

Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

UNIT-II Vehicle Body Materials — 8 hours

Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrene, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion, and their prevention.

UNIT-III Aerodynamics and Load Distribution — 8 hours

Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

Load Distribution:

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

UNIT-IV Interior Ergonomics and Vehicle Stability — 8 hours

Interior Ergonomics: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers' visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

Vehicle Stability:

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

UNIT-IV Noise and Vibrations — 9 hours

Noise and Vibration: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

Impact protection:
Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

Course outcome: After completion of this course students will be able to

CO1	Understand the classification of the vehicles on the basis of body.	K2
CO2	Understand the importance of material selection in designing automotive bodies.	K2
CO3	Understand the concepts of aerodynamics used in designing automobiles.	K2
CO4	Understand the importance of interior and exterior ergonomics while designing the vehicle.	K2
CO5	Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.	K2

Text books

7. Powloski J., "Vehicle Body Engineering", Business books limited, London, 1969.
8. Vehicle body engineering Giles J Pawlowsky Business books limited 1989
9. Vehicle body layout and analysis John Fenton Mechanical Engg. Publication ltd, London. 1990

Reference Books

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.
3. Vehicle Safety 2002 Cornwell press Town bridge, UK ISBN 1356 – 1448
4. Aerodynamics of Road Vehicles W.H. Hucho Butter worth's 1987 4th Edition

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1 https://youtu.be/924_ZQMQh10

Unit 2 https://youtu.be/qxNTQozl5fE

Unit 3 https://youtu.be/qxNTQozl5fE

Unit 4 https://youtu.be/qQkszLYPjm4

Unit 5 https://youtu.be/qHvlqbjJ3uM

Bachelor of Technology Third Year			
Course code	**AME0612**	**L-T-P**	**Credits**
Course title	**RAPID PROTOTYPING & MANUFACTURING (ADDITIVE MANUFACTURING)**	**3-0-0**	**3**
Course objective:			
1	Understand the Fundamentals of various Rapid Prototyping Technologies for Application to various Industrial needs	K1,K2	
2	Able to convert part file into STL format & Generating STL file from various Sources and Further Process	K3, K4	
3	Able to understand the method of Manufacturing of Liquid Based, Powder Based and Solid Based RP Techniques	K3	
4	Understand the Manufacturing procedure of a Prototype using FDM, SLA Techniques	K3	
5	Understand the broad aspects of Rapid Prototyping and Interconnected & Interdisciplinary Applications & Techniques	K4, K5	

Pre-requisites:
Basic knowledge of material science engineering i.e. polymers and composites and their properties.

Course Contents / Syllabus

UNIT-I	**Introduction**	**6 hours**

Prototyping Fundamentals, Historical Development, Advantages of RP, Commonly Used Terms, 3D Modeling, 3D Scanning, Data Conversion and Transmission, Checking, Repairing and Preparing (Slicing), Pre Processing, Building, Post Processing, RP Data Formats, Classification of RP Process with Different Aspects, Applications & Limitations

UNIT-II	**Liquid Based RP Systems**	**10 hours**

Stereo Lithography Apparatus (SLA): Models and Specifications, Process, Working Principle, Photopolymers, Photo Polymerization, Light Sources, Industrial Applications, Advantages and Disadvantages, case studies, Practical Demonstration. **Solid Ground Curing (SGC):** Models and Specifications, Process, Working, Principle, Industrial Applications, Advantages and Disadvantages. **PolyJet:** Models and Specifications, Process, Working, Principle, Industrial Applications, Advantages and Disadvantages and case studies.

UNIT-III	**Solid Based RP Systems**	**10 hours**

Laminated Object Manufacturing (LOM): Models and Specifications, Process, Working Principle, Industrial Applications, Advantages and Disadvantages, Case Studies. **Ultrasonic Consolidation:** Models and Specifications, Process, Working Principle, Industrial Applications, Advantages and Disadvantages, Case Studies. **Fused Deposition Modeling (FDM):** Models and Specifications, Process, Working Principle, Industrial Applications, Advantages and Disadvantages, Case Studies, Practical Demonstration. Solid Based RP Systems, Materials and Parameters.

UNIT-IV	**Powder Based RP Systems**	**10 hours**

Selective Laser Sintering (SLS): Models and Specifications, Process, Working Principle, Industrial Applications, Advantages and Disadvantages, Case Studies. **Binder Jetting**: Models and Specification, Process, Working Principle, Industrial Applications, Advantages and Disadvantages, Case Studies. **Inkjet Fusion:** Models and Specification, Process Working Principle, Industrial Applications, Advantages and Disadvantages, case Studies. Powder Materials for Powder Based RP Systems

UNIT-V	**Advancement in RP Technology**	**8 hours**

Composite 3D Printing: Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies, Materials, Practical Demonstration. **Interdisciplinary Applications:** Biomedical, Dental, Prosthetics, Fashion, Food, Architecture etc. **Industrial trends in RP:** DFRP, Design Applications & Advancement in Manufacturing, Tooling & Production. Batch Production and Associated Technologies: Vacuum Casting, Thermo Forming etc.

Course Outcome: After completion of this course students will be able to		
CO1	Understand the fundamentals of Rapid Prototyping Technologies for Engineering Applications	K1, K2
CO2	Understand the methodology to Manufacture the Products using SLA, SGC, PolyJet and CLIP Technologies and study their Applications , Advantages and Case Studies & Materials	K3, K4
CO3	Understand the methodology to Manufacture the Products using LOM, Ultrasonic Consolidation and FDM Technologies and study their applications , advantages and case studies & Materials	K3
CO4	Understand the methodology to Manufacture the Products using SLS, Binder Jetting and InkJet Fusion Technologies and study their Applications , Advantages and Case Studies & Materials	K3
CO5	Understand the Advancements, Scopes, Design Aspects & Associated Applications & Techniques	K4, K5

Text Books:

1. Sanjay Kumar, "Additive Manufacturing Processes", Springer 2020.
2. Ian Gibson, Davin Rosen, Brent Stucker "Rapid Prototyping Technologies, Springer, 2nd Ed, 2014

Reference Books:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
3. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000
4. Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1 https://www.youtube.com/watch?v=NkC8TNts4B4

Unit 2 https://www.youtube.com/watch?v=5FC6onIkVH8

Unit 3 https://www.youtube.com/watch?v=ICjQ0UzE2Ao

Unit 4 https://www.youtube.com/watch?v=oTIKEIaBWO8

Unit 5 https://www.youtube.com/watch?v=MutAvQVhK5g

B TECH THIRD YEAR			
Course Code	**AME0614**	**L T P**	**Credits**
Course Title	**PRODUCT LIFECYCLE MANAGEMENT**	**3-0-0**	**3**

Course Objectives:

1	To integrate systematic approaches of innovative product lifecycle management using design thinking with an awareness of business considerations needed to produce products.	K_1, K_2, K_3
2	To develop ability to employ state-of-the-art technology in product and process development and be PLM proficient.	K_2, K_3
3	To develop skills to support product realization, including prototype, testing, validation and marketing.	K_2, K_3
4	To introduce the latest trends and technology in digital manufacturing.	K_2, K_3, K_4
5	To familiarize with the concepts of PLM strategy and application.	K_2, K_3

Pre-requisites:

Students should have basic knowledge product design & development and manufacturing.

Course Contents / Syllabus

UNIT-I	**Introduction to Product Life Cycle Management (PLM)**	**8 Hours**

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Views, Components and Phases of PLM, PLM feasibility Study, PLM Visioning. Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM

.**Collaborative Product Development:** Engineering Vaulting, Product Reuse, Smart Parts, Engineering, Change Management

UNIT-II	**Collaborative Product Development& Digital Manufacturing – PLM**	**8 Hours**

Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral. Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

UNIT-III	**Developing a PLM Strategy and Conducting a PLM Assessment**	**8 Hours**

Strategy, Impact of strategy, implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.

Basic Concepts and Introduction – Procurement, Supply Chain Management, Project Procurement and Subcontract Management, Vendor Management, Inventory Management.

UNIT-IV	**Project Cost Management**	**8 Hours**

Essentials of Cost Management, Cost Estimation, Cost Budget and Variance Analysis, Cost Monitoring and Control, Essentials of Project Cash Flows.

Quality & EHS Management: Defining Quality, Construction Project Quality, Quality Management System, 7 Quality Tools, Control Chart & Cost of Quality. Introduction to Occupational Health, Safety and Environment,

UNIT-V	**Project Risk Management, Project Monitoring & Control.**	**8 Hours**

Risk Introduction: Risk Introduction, Risk Analysis, Risk Response Strategy and Implementation, Introduction to Project Monitoring and Controlling, Analysis Techniques, Visualization Techniques, Elements of Control, Monitor and Control Schedule, Cost and Resources, MS Project:		
Course outcome: After completion of this course students will be able to		
CO1	Understand the concept of Product Life Cycle Management.\ & Work flow	K_1, K_2, K_3
CO2	Know on the product realization, including prototype, testing, validation and marketing.	K_2, K_3
CO3	Identify and prioritize risks and Implement risk response	K_2, K_3
CO4	Understand the cost of quality, importance of managing environment, health, and safety in projects	K_2, K_3
CO5	Describe the project monitoring process and Explain the supply chain strategies	K_2, K_3
SELF-STUDY		
Students shall be assigned with topics related to the latest technological developments in field of product life cycle management		
TEXT BOOKS:		
1. Product Lifecycle Management: Grieves, Michael, McGraw-Hill Publications, Edition 2013, ISBN:978-0071452304.		
2. Product Lifecycle Management Volume I : Stark, John, Springer, 3rd Edition, 2016, ISBN: 978-3319174396.		
3. Product Lifecycle Management Volume II : Stark, John, Springer, 3rd Edition, 2016, ISBN: 978-3319244341		
REFERENCE BOOKS:		
1. Fabio Guidice, Guido La Rosa, Product Design for the environment -A lifecycle approach, Taylor and Francis 2013, ISBN:978-1420001044		
2. Robert J.Thomas, "NDP: "Managing and forecasting for strategic processes", Wiley Publications, 2013 ISBN:978-0471572268		
3. Stark, John, "Product Life cycle Management: Paradigm for 21st Century Product		
4. Realization", Springer-Verlag, 2015. ISBN:978-3-319-17440-2		
5. PDM : Product Data Management : Burden, Rodger, Resource Pub,2013.ISBN:978- 0970035226		
6. PDM : Product Data Management : Burden, Rodger, Resource Pub,2013.ISBN:978- 0970035226		
SUGGESTED SOFTWARE PACKAGES: Windchill & associated PTC packages (PLM)		
Link: NPTEL/ YouTube/ Faculty Video Link:		
Unit 1 https://youtu.be/HN9GtL21rb4		
Unit 2 https://archive.nptel.ac.in/courses/110/104/110104084/		
Unit 3 https://archive.nptel.ac.in/courses/110/104/110104084/		
Unit 4 https://archive.nptel.ac.in/courses/110/104/110104084/		
Unit 5 https://youtu.be/dcup4kRxSEs		

Course Code	AME0651	LTP	Credit
Course Title	Machine Design Lab	0-0-2	1

Suggested list of Experiment	
Sr. No.	**Name of Experiment**
1.	Review of drawing & editing command in PTC Creo / AutoCAD.
2.	Draw 2D model of 4 bar mechanism.
3.	Draw 3D model of single slider crank mechanism.
4.	Design & Analysis of shaft subjected to bending.
5.	Design & Analysis of shaft subjected to twisting.
6.	Design & Analysis of shaft subjected to combined loading.
7.	Design & Analysis of stress concentration in one of the machine elements.
8.	Design & Analysis of closed coil helical spring.
9.	Design & Analysis of gear.
10.	Design & Analysis of bearing.

Lab Course Outcome: After completion of this course students will be able to	
CO 1	Draw the design problem into design software in the form of 2D or 3D model.
CO 2	Apply the governing equations and formulate the boundary conditions.
CO 3	Evaluate the various aspects related to the design of machine elements viz. technical, economic, social & environmental viability.
CO 4	Design the machine elements ensuring its quality & functionality satisfactorily.

Course Code	AME0654	LTP	Credit
Course Title	AI & ML lab	0-0-2	1

Suggested list of Experiment -(At least 8 experiments of the following)	
Course Objective: This course will enable students to	
1. Make use of Data sets in implementing the machine learning algorithms	
2. Implement the machine learning concepts and algorithms in any suitable language of choice.	
Sr. No.	**Name of Experiment**
1	Write a program to perform various types of regression (Linear &Logistic)
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample
4	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy, precision and recall for test data set.
5	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
6	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program
7	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
8	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
9	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
10	Write a program to implement an AI chatbot
11	Write a program to perform the TIK TAK TOE program
12	Write a program to perform Breadth first search
13	Write a program to perform Water Jug Problem
14	Write a Program to perform simple Calculator
Lab Course Outcome: After completion of this course students will be able to	
CO1	Understand the implementation procedures for the ML algorithm.
CO2	Identify and apply machine learning algorithms to solve real world problems.
CO3	Apply searching problems using various algorithms. Explain functionality of Chat-bot.
CO4	Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
Reference Books	
1.	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2.	Hal Daume III, A Course in Machine Learning, 2015
3.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2009
4.	John Hopcroft, Ravindran Kannan, Foundations of Data Science, 2014

Course Code	AME0652	L-T-P	Credit
Course Title	REFRIGERATION AND AIR CONDITIONING LAB	0-0-2	1

Suggested list of Experiment -(At least 8 experiments of the following)	
Sr. No.	**Name of Experiment**
1	Experiment on refrigeration test rig and calculation of various performance parameters.
2	To study different types of expansion devices used in refrigeration system.
3	To study different types of evaporators used in refrigeration systems.
4	To study basic components of air-conditioning system.
5	Experiment on air-conditioning test rig & calculation of various performance parameters.
6	Experiment on water cooling tower to evaluate its performance
7	Study of window air conditioner.
8	To study different types of compressors used in refrigeration and air conditioning systems.
9	Visit of a central air conditioning plant and its detailed study.
10	Visit of cold-storage and its detailed study.
11	Experiment on Desert coolers.
12	To study different types of condensers used in refrigeration and air conditioning systems.

Lab Course Outcome:	
CO 1	Demonstrate practical understanding of Simple vapour compression refrigeration system.
CO 2	Demonstrate working understanding of types of evaporators, condensers, compressors and expansion devices used in refrigeration system.
CO 3	Analyze and calculate the performance of refrigeration test rig.
CO 4	Calculate coefficient of performance of air-conditioning test rig.
CO 5	Demonstrate the complete working of window air conditioner.

Link:	
Unit 1	shorturl.at/xyT36 Shorturl.at/bexyz Shorturl.at/stvP0 Shorturl.at/akrtP shorturl.at/vLV23
Unit 2	shorturl.at/qHKMQ Shorturl.at/bhtxy Shorturl.at/fACEX Shorturl.at/opyKS shorturl.at/sHR19
Unit 3	shorturl.at/jlCR5 Shorturl.at/adew9 Shorturl.at/chmM6 Shorturl.at/ikpuS shorturl.at/gwFIX
Unit 4	shorturl.at/dmwUX

	Shorturl.at/ajmS7 Shorturl.at/auLY4 Shorturl.at/btD37 shorturl.at/nqP08
Unit 5	shorturl.at/HUWZ4 Shorturl.at/IKS29 Shorturl.at/giuAM

B. TECH. THIRD YEAR

Course Code	ANC0601	L T P	Credits
Course Title	CONSTITUTION OF INDIA, LAW AND ENGINEERING	2 0 0	2

Course objective: To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.

Pre-requisites: Computer Organization and Architecture

Course Contents / Syllabus

UNIT-I	INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION	8 Hours

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

UNIT-II	UNION EXECUTIVE AND STATE EXECUTIVE	8 Hours

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of Vice-President, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

UNIT-III	INTRODUCTION AND BASIC INFORMATION ABOUT LEGAL SYSTEM	8 Hours

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

UNIT-IV	INTELLECTUAL PROPERTY LAWS AND REGULATION TO INFORMATION	8 Hours

Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information, Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

UNIT-V	BUSINESS ORGANIZATIONS AND E-GOVERNANCE	8 Hours

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

COURSE OUTCOMES: After completion of this course students will be able to

CO 1	Identify and explore the basic features and modalities about Indian constitution.	K1
CO 2	Differentiate and relate the functioning of Indian parliamentary system at the center and state level.	K2
CO 3	Differentiate different aspects of Indian Legal System and its related bodies.	K4
CO 4	Discover and apply different laws and regulations related to engineering practices.	K4
CO 5	Correlate role of engineers with different organizations and governance models	K4

Text Books:

4. M Laxmikanth: Indian Polity for civil services and other State Examination,6th Edition, Mc Graw Hill
5. Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.
6. Granville Austin: The Indian Constitution: Cornerstone of a Nation (Classic Reissue), Oxford University Press.

Reference Books:

1. Madhav Khosla: The Indian Constitution, Oxford University Press.
2. PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
3. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)

B. TECH. THIRD YEAR

Course Code	ANC0602	L T P	Credits
Course Title	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2 0 0	2

Course objective: This course aims to provide basic knowledge about different theories of society, state and polity in India, Indian literature, culture, Indian religion, philosophy, science, management, cultural heritage and different arts in India

Pre-requisites: Computer Organization and Architecture

Course Contents / Syllabus

UNIT-I	SOCIETY STATE AND POLITY IN INDIA	8 Hours

State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women.

UNIT-II	INDIAN LITERATURE, CULTURE, TRADITION, AND PRACTICES	8 Hours

Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali,Prakrit And Sanskrit, Sikh Literature, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature,Malayalam Literature ,Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature

UNIT-III	INDIAN RELIGION, PHILOSOPHY, AND PRACTICES	8 Hours

Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines, Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.

UNIT-IV	SCIENCE, MANAGEMENT AND INDIAN KNOWLEDGE SYSTEM	8 Hours

Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India, Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times.

UNIT-V	CULTURAL HERITAGE AND PERFORMING ARTS	8 Hours

Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Pottery, Painting, Indian Handicraft, UNESCO'S List of World Heritage sites in India, Seals, coins, Puppetry, Dance, Music, Theatre, drama, Martial Arts Traditions, Fairs and Festivals, UNESCO'S List of Intangible Cultural Heritage, Calenders, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema.

COURSE OUTCOMES: After completion of this course students will be able to

CO 1	Understand the basics of past Indian politics and state polity.	K2
CO 2	Understand the Vedas, Upanishads, languages & literature of Indian society.	K2
CO 3	Know the different religions and religious movements in India.	K4
CO 4	Identify and explore the basic knowledge about the ancient history of Indian agriculture, science & technology, and ayurveda.	K4
CO 5	Identify Indian dances, fairs & festivals, and cinema.	K1

Text Books:

3. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
4. S. Baliyan, Indian Art and Culture, Oxford University Press, India
5. Nitin Singhania, Indian Art and Culture: for civil services and other competitive Examinations,3rd Edition,Mc Graw Hill

Reference Books:

1. Romila Thapar, Readings In Early Indian History Oxford University Press, India
2. Basham, A.L., The Wonder that was India (34th impression), New Delhi, Rupa & co.