

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW



Evaluation Scheme & SyllabusFor

Bachelor of Technology Mechanical Engineering

Third Year

(Effective from the Session: 2025-26)

Bachelor of Technology Mechanical Engineering

Evaluation Scheme

SEMESTER-V

Sl.	Subject	Subject	Types of	7 -			Er Semo		Total	Credit				
No.	Codes		Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BCSCC0501	Design Thinking - II	Mandatory	2	1	0	30	20	50		100		150	3
2	BME0501	Theory of Machines	Mandatory	3	1	0	30	20	50		100		150	4
3		Department Elective-I	Department Elective	3	0	0	30	20	50		100		150	3
4		Department Elective-II	Department Elective	3	0	0	30	20	50		100		150	3
5	BME0552	Augmented Reality & Virtual Reality	Mandatory	0	0	6				50		100	150	3
6	BME0553	Automotive Mechatronics	Mandatory	0	0	6				50		100	150	3
7	BME0551	Theory of Machines Lab	Mandatory	0	0	4				50		50	100	2
8	BME0559	Internship Assessment - II	Mandatory	0	0	2				50			50	1
9	BNC0502/ BNC0501	Essence of Indian Traditional Knowledge/ Constitution of India, Law and Engineering	Compulsory Audit	2	0	0	30	20	50		50		100	NA
10		*Massive Open Online Courses (For B.Tech. Hons. Degree)												
		TOTAL		13	2	18	120	80	200	200	400	250	1050	22

* List of MOOCs Based Recommended Courses for Second year (Semester-V) B. Tech Students

Sr. No.	Sr. No. Subject Course Name		University / Industry Partner Name	No of Hours	Credits
1	BMC0071	CAD automation using CATIAv5VBA	Infosys Wingspan (Infosys Springboard)	15 h	1
2	BMC0086	Java Programming Fundamentals	Infosys Wingspan (Infosys Springboard)	36h 10m	3
3	BMC0088	Lean Six Sigma Green Belt - 2022	Infosys Wingspan (Infosys Springboard)	11h 7 m	0.5

PLEASE NOTE: -

- A 3-4 weeks Internship shall be conducted during summer break after semester-II and will be assessed during semester-III
- Compulsory Audit (CA) Courses (Non-Credit BNC0301/BNC0302)
 - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
 - The 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., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

List of Departmental Electives

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Bucket Name	Branch	Semester
1	BME0511	Factory Automation	Departmental Electives -I	Industry 4.0	ME	5
2	BME0513	Industrial Robots	Departmental Electives –II	maustry 4.0	ME	5
3	BME0512	Automotive Engineering	Departmental Electives -I	Automotive	ME	5
4	BME0514	Automotive Engines	Departmental Electives -II	Engineering	ME	5

Bachelor of Technology Mechanical Engineering

Evaluation Scheme SEMESTER-VI

Sl.	Subject	Subject	Types of	P	eriod	ls	Evaluation Schemes				End Semester		Total	Credit
No.	Codes		Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BME0601	Refrigeration & Air Conditioning	Mandatory	3	1	0	30	20	50		100		150	4
2		Departmental Elective- III	Department Elective	3	0	0	30	20	50		100		150	3
3		Departmental Elective- IV	Department Elective	3	0	0	30	20	50		100		150	3
4		Open Elective - I	Open Elective	3	0	0	30	20	50		100		150	3
5	BME0652	Product Lifecycle Management	Mandatory	0	0	6				50		100	150	3
6	BME0653	Industrial Automation & IOT	Mandatory	0	0	6				50		100	150	3
7	BME0651	Refrigeration & Air Conditioning Lab	Mandatory	0	0	2				25		25	50	1
8	BME0659	Mini Project	Mandatory	0	0	6				50		100	150	3
9	BNC0602/ BNC0601	Essence of Indian Traditional Knowledge/ Constitution of India, Law and Engineering	Compulsory Audit	2	0	0	30	20	50		50		100	NA
10		*Massive Open Online Courses (For B.Tech. Hons. Degree)												
		Total		13	1	20	120	80	200	175	400	325	1100	23

* List of MOOCs Based Recommended Courses for Second vear (Semester-VI) B. Tech Students

S. No.	S. No. Subject Code Course Name		University / Industry Partner Name	No of Hours	Credits
1	BMC0012	Data Structures and Algorithms using Python - Part 1	Infosys Wingspan (Infosys Springboard)	29h 27m	2
2	BMC0099	Sustainable Supply Chains	Infosys Wingspan (Infosys Springboard)	6h	0.5

PLEASE NOTE: -

- A 3-4 weeks Internship shall be conducted during summer break after semester-IV and will be assessed during Semester-V
- Compulsory Audit (CA) Courses (Non-Credit BNC0401/BNC0402)
 - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
 - The 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., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

List of Departmental Electives

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Bucket Name	Branch	Semester
1	BME0611	Smart Manufacturing	Departmental Electives-III	Industry 4.0	ME	6
2	BME0613	Machine Learning in Manufacturing	Departmental Electives-IV		ME	6
3	BME0612	Automotive Transmission & Suspension Systems	Departmental Electives-III	Automotive	ME	6
4	BME0614	Automotive Manufacturing & Materials	Departmental Electives-IV	Engineering	ME	6

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 to 18 = 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

	B. TECH THIRD YEAR		
Subject C	ode: BCSE0503	LT P: 210	
Subject N	lame: Design Thinking-II	Credits: 3	
Pre- re	quisites: Student must complete Design Thinking-I course.		
	Course Contents/Syllabus		
Unit-1	Design thinking & Innovation, Design Thinking Mindset and Principles, rec Thinking, Design Approaches, additional in-depth examples of each design ap with Why, The Golden Circle, Asking the "Why" behind each example (an in-c, The Higher Purpose, in-class activity for LDO & sharing insights Visualization and it's importance in design thinking, reflections on whe visualization & Wheel of Life), Linking it with Balancing Priorities (in class act of Americas' Keep the Change Campaign. Litter of Light & Arvind Eye Care E application of design thinking tools and concepts, case study on McDonald's M Ecommerce & Gillette Working on 1-hour Design problem, Applying RCA and Brainstorm on innoval Main project allocation and expectations from the project.	proaches. Simon Sinek's – Start class activity of asking 5-WHYS) el of life (in-class activity for tivity), DBS Singapore and Bank xamples, understanding practical filkshake / Amazon India's Rural	8 hours
Unit-2	Refine and narrow down to the best idea, 10-100-1000gm, QBL, Design T Analysis for 1000gm discussion. In-class activity for 10-100-1000gm & QBL Prototyping (Convergence): Prototyping mindset, tools for prototyping – Sketch physical mockups, Interaction flows, storyboards, acting/role-playing etc, import for revisiting Brainstormed ideas. Napkin Pitch, Usability, Minimum Viable Prototype, Connecting Prototype wit Launch. Decision Making Tools and Approaches – Vroom Yetton Matrix Proposition, Case study: Careerbuddy, You-Me-Health Story & IBM Learning prototyping – paper-pen / physical prototype/ digital prototype of project's 1000	ing, paper models, pseudo-codes, rtance of garnering user feedback h 3 Laws, A/B Testing, Learning k, Shift-Left, Up, Right, Value ag Launch. In-class activities on	8 hours
Unit-3	Storytelling: Elements of storytelling, Mapping personas with storytelling, Ar Successful Campaigns of well-known examples, in-class activity on storytelling conducting usability test, testing as hypothesis, testing as empathy, observ Guerrilla Interviews, validation workshops, user feedback, record results, en Software validation tools, design parameters, alpha β testing, Taguch sampling. Final Project Presentation and assessing the impact of using design the	t of influencing, Elevator Pitch, g. Testing of design with people, ration and shadowing methods, hance, retest, and refine design, i, defect classification, random	8 hours
Unit-4	Innovation: Need & Importance, Principles of innovations, Asking the Right Q Rationale for innovation, Quality: Principles & Philosophies, Customer percept FinTech case study of Design Thinking application – CANVAS Leadership, types, qualities and traits of leaders and leadership styles, Leaders Leaders & Managers, Connecting Leaders-Managers with 13 Musical Notes, T Situational Model), Team Building Models: Tuckman's and Belbin's. Importarinnovation.	vs Manager, Personas of rait theory, LSM (Leadership	8 hours
Unit-5	Comprehensive human goal: the five dimensions of human endeavour (Manax Right living (Sikhsa- Sanskar), Health – Self-regulation (Swasthya - Sanyam) Suraksha), Production – Work (Utpadan – Karya), Exchange – Storage (Vi Charitra (Shifting the Thinking). Interconnectedness and mutual fulfilment among the four orders of nature reconature, Thinking expansion for harmony: Self-exploration (Johari's window) behaviour and skills, Myers-Briggs personality types (MBTI), FIRO-B test to reconstructions.	, Justice – Preservation (Nyaya- nimya – Kosh), Darshan-Gyan- cyclability and self-regulation in , group behaviour, interpersonal	8 hour
Course (Outcomes –		
CO1	Learn sophisticated design tools to sharpen their problem-solving skills		K2
CO2	Construct innovate ideas using design thinking tools and converge to feasible	e idea for breakthrough solution	K6
CO3	Implement storytelling for persuasive articulation		К3
CO4	Understanding the nature of leadership empowerment		K2
CO5	Understand the role of a human being in ensuring harmony in society and na	· · · · · · · · · · · · · · · · · · ·	K2

Text Books:

Arun Jain, UnMukt: Science & Art of Design Thinking, 2020, Polaris

Gavin Ambrose and Paul Harris, Basics Design 08: Design Thinking, 2010, AVA Publishing SA.

R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, First Edition, 2009, Excel Books: New Delhi

Reference Books:

Jeanne Liedta, Andrew King and Kevin Benett, Solving Problems with Design Thinking – Ten Stories of What Works, 2013, Columbia Business School Publishing.

Dr Ritu Soryan, Universal Human Values and Professional Ethics, 2022, Katson Books.

Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey.

Roger L. Martin, Design of Business: Why Design Thinking is the Next Competitive Advantage, 2009, Harvard Business Press, Boston MA.

Tim Brown, Change by Design, 2009, Harper Collins.

Pavan Soni, Design your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, 2020, Penguin Books.

Links: NPTEL/You Tube/Web Link

- 1. https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
- 2. https://www.youtube.com/watch?v=dT-0HzgmudU
- 3. https://www.youtube.com/watch?v=oQrcPiQuCHI
- 4. https://www.youtube.com/watch?v=BjkxYZ93Fbs
- 5. https://www.youtube.com/watch?v=fEdz91oWrts
- 6. https://www.youtube.com/watch?v=oZhR1HPdvR4
- 7. https://www.youtube.com/watch?v=CI9xMNvTLFI
- 8. https://www.youtube.com/watch?v=OIZXxPVpmBs
- 9. https://www.youtube.com/watch?v=FydJu1A1oeM
- 10. https://www.youtube.com/watch?v=ty3O5CNaMy8

Subject C	ode: BME0501	LTP:310	
Subject N	lame: Theory of Machines	Credits: 4	
Pre- red	quisites: Basic knowledge of Engineering Mechanics, Basic knowledge of	Engineering Mathematics, Basic know	vledge of
Engmeerin	Course Contents/Syllabus		
Unit-1	Mechanism: Introduction, mechanisms and machines, kinematics and kinematic pairs and their classification, kinematic chain, constraint motion mechanism, Grobler's equation, inversion of four bar chain, single slider crechain. Velocity Analysis: Introduction, velocity of point in mechanism, relative method, Kennedy's theorem, velocities in four bar and slider crank mechanish Acceleration Analysis: Introduction, acceleration of a point on a link, Coracceleration in four bar and slider crank mechanism, crank and slotted lever in	on, degrees of freedom of planar ank chain and double slider crank velocity and instantaneous centre m. iolis's component of acceleration,	8 hours
Unit-2	Cam and Follower: Introduction, classification of cams and followers, tern knife edge, roller and flat faced followers for uniform velocity, simple harmound retardation. Gears and Gear Trains: Introduction, classification of gears, terminology of gear, law of gearing, to systems of gear teeth, length of path of contact and arc of contact, contact regear and pinion to avoid interference, simple, compound, reverted and epicycontact.	minology of cam, cam profiles for onic motion, uniform acceleration, ooth forms and their comparisons, atio, minimum number of teeth on	8 hours
Unit-3	Force Analysis: Static force analysis of mechanisms, D'Alembert's principle, dynamic force analysis, piston effort, crank effort and turning moment on crank Flywheel: Flywheels and its function, turning moment diagrams for single cy four stroke IC engine and multi-cylinder engines, fluctuation of energy and s	re analysis of planar mechanisms, ashaft.	8 hours
Unit-4	Balancing: Introduction, static balancing, and dynamic balancing, balancing and different plane, graphical and analytical methods, balancing of reciprocat Governor: Introduction, governor and its function, types of governors, centrigovernors, dead weight and spring controlled centrifugal governors, sensitivities isochronous governor, hunting of centrifugal governors, effort, and power of	of rotating masses in same plane ing masses. fugal governors and inertia cy and stability of governor,	8 hour
Unit-5	Gyroscope: Gyroscopic couples, Gyroscopic stabilization of shaft bearing, as wheel and two-wheel vehicles moving on curved paths. Dynamometers: Dynamometers, types of dynamometers, prony brake as transmission, epicyclic and torsion dynamometer.	ro plane and ships, stability of four	8 hours
Course (Outcomes –		
CO1	Design linkage or mechanism with their inversions for industrial equipme and requirements and Perform mechanism analysis to find the position, vermulti-bar mechanisms.		К3
CO2	Calculate the amount of power transmission through the gear drive and ca	lculate their driving efficiencies.	К3
CO3	Understand balancing of reciprocating and rotary masses through solving	0 01	К3
CO4	Analyze the static and dynamic force analysis of various mechanism and or	-	K4
CO5	Understand the gyroscopic forces and couple and its effect on the stability	of aero-plane and ship.	К3
Text Bo	ooks:		
Theory	of Machines by S.S. Rattan, McGraw Hill.		
Theory o	of Machines by R. K. Bansal, Laxmi Publications.		
Tl	of Machines by Khurmi & Gupta, S. Chand Publication.		

Reference Books: Mechanics of Machines by V. Ramamurti, Alpha Science Theory of Machines and Mechanisms by Rao & Dukkipati, bohem press Theory of Mechanisms and Machines by Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press. Theory of Machines and Mechanisms by Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press Links: NPTEL/You Tube/Web Link https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8 https://www.youtube.com/watch?v=dT-0HzgmudU https://www.youtube.com/watch?v=oQrcPiQuCHI https://www.youtube.com/watch?v=BjkxY293Fbs https://www.youtube.com/watch?v=fEdz91oWrts https://www.youtube.com/watch?v=oZhR1HPdvR4 https://www.youtube.com/watch?v=oZhR1HPdvR4

https://www.youtube.com/watch?v=OIZXxPVpmBs

https://www.youtube.com/watch?v=FydJu1A1oeM https://www.youtube.com/watch?v=ty3O5CNaMy8

B. TECH THIRD YEAR							
Course Code	BME0552	L	Т	Р	Credit		
Course Title	Augmented, Virtual & Mixed Reality	0	0	6	3		
_	s the technical and experiential design foundation	_		_			
environments in current and future virtual	l, augmented and mixed reality platforms. During t	he durati	on of the o	course stude	nts are expected		

environments in current and future virtual, augmented and mixed reality platforms. During the duration of the course students are expected to work in collaborative group projects and develop working prototypes, demo experiences, immersive platforms, unique controllers and new innovative technologies that can be used in the development and production of immersive environments in the fields of entertainment, education, training, medical and industrial innovation.

Pre-requisites: Students should have basic knowledge of product design & development and manufacturing.

Course Contents / Syllabus

Suggested list of Experiment

Sr. No	o. Name of Experiment
1	Introduction & Understanding to Augmented Reality Concepts
2	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
3	Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
4	Develop a scene in Unity that includes, a cube, plane and sphere, apply transformations on the 3 game objects, add a video and audio source.
5	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene.
6	Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component, material and Box collider to the game Objects. Study to grab and throw the sphere using vr controller.
7	Develop a simple U I(User interface) menu with images, canvas, sprites and button. Interact with UI menu through VR trigge button such that on each successful trigger interaction display a score on scene
8	Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
9	Include animation and interaction in the immersive environment created.
10	Develop a VR environment for flying helicopter/moving car simulation.
11	Develop a VR game in Unity such that on each gun trigger click, destroy the cubes placed on the plane and gain a score point. Make a score UI and display it on the screen.
12	Welcome to Vuforia Studio
13	Supported Devices, Operating System, and Browser
14	Install Vuforia Studio
15	Core Components and Concepts
16	Understanding Thing Mark
17	Create and publish the mobile Experience-Introduction
18	Add 2D widgets to a Mobile Experience
19	Bind a 2D Widget to a 3D Model
20	Use a Sequence List in an Experience
21	Projects development e.g.: Creating Simple AR Experiences, Coffee Maker Add Project, Robot Service Projects, Blue pump

Course outcome: After completion of the course, the student will be able to

Project.

CO 1	To introduce Augmented, Virtual & Mixed Reality, the tool of Industry 5.0.	К3
CO 2	To develop content & use various types of Hardware and Software in Virtual Reality systems.	К3
CO 3	To develop content & use various types of Hardware and Software in Augmented Reality systems.	К3
CO4	To apply VR, AR, MR, and XR in the real-world scenarios during the project lifecycle.	К3
CO 5	To understand the applications of AR, VR, MR & XR	K3

В. Т	TECH THIRD YEAR	
Subject Code: BME0553	L T P: 0 0 6	
Subject Name: Automotive Mechatronics	Credits: 3	
Pre- requisites: Foundational knowledge in med	hanical engineering and materials science.	
Cou	rse Contents/Syllabus	
in automobiles Key components: sensors, ac	Definition, scope, and importance of mechatronics ctuators, ECUs Overview of automotive systems infotainment) Trends in automotive mechatronics	4 hours
Automotive Sensors and Actuators-Common	n sensors in vehicles: temperature, position, speed, nciples and characteristics Actuators: solenoids, conditioning and data acquisition basics	4 hours
Unit-3 Electronic Control Units (ECU) and Commod of ECUs in vehicles Memory organization networks: CAN, LIN, FlexRay, and MOST Di	nunication Protocols- Architecture and functions, Input/Output handling Overview of in-vehicle agnostics and OBD-II basics	4 hours
Unit-4 Control Systems and Applications in Vehicl Open-loop vs closed-loop systems Cruise comprise-by-wire systems	les- Basics of control theory in automotive context trol, ABS, TCS, and electronic stability control	4 hours
Mechatronics in Electric and Hybrid Vehicl motor control with ECUs Battery Managemen recovery systems Introduction to vehicle diagram.		4 hours
Text Books:		
Introduction to Manufacturing Processes, N	I. Mikell P. Groover	
Manufacturing Processes for Engineering N	Materials", Serope Kalpakjian & Steven R. Schmid	
Materials Science and Engineering: An Intr		
Principles of Materials Science and Engineer	ering", William F. Smith	
Reference Books:		
	terials, Processes, and Systems, Wiley. (2015), Groover,	M.P.
Manufacturing Engineering and Technology, P		
Manufacturing Processes for Engineering Mat	erials, Pearson. (2019), Serope Kalpakjian, Steven R. Sch	ımid
Fundamentals of Engineering Materials, McGr	raw-Hill. (2014), Jain, R.K.	
Engineering Materials 1: An Introduction to Pr & Jones, D.R.H.	roperties, Applications, and Design, Butterworth-Heiner	nann. (2012), Ashby, M.F
Links: NPTEL/You Tube/Web Link		
https://archive.nptel.ac.in/courses/107/106/10	07106088/	
https://archive.nptel.ac.in/courses/112/107/11	2107219/	
https://archive.nptel.ac.in/courses/112/103/11	2103293/	
https://www.youtube.com/watch?v=2rxbxNem	n1il&list=PLyqSpQzTE6M ON8uXt-PP8uX6hMWJeYSJ	

Sugges	ted list of Experiment	
Sr. No.	Name of Experiment	
1	Study and identification of mechatronic systems in a modern vehicle (engine, transmission, braking, etc.).	
2	Demonstration of ECUs and basic vehicle communication layout using a cut-section of a car.	
3	Case study presentation on an advanced mechatronic system, e.g., ADAS or electric power steering.	
4	Measurement of temperature, speed, and position using commonly used vehicle sensors (thermistors, hall-expotentiometers).	ffect,
5	Simulation and testing of sensor outputs using DAQ systems and oscilloscope or LabVIEW.	
6	Demonstration and control of actuators (solenoids, DC motors, pneumatic actuators) via microcontrollers.	
7	Hands-on with a basic ECU trainer kit: Reading inputs and outputs (I/O) and controlling vehicle subsystems	3.
8	Simulate CAN bus communication between two ECUs using CANoe or MATLAB/Simulink.	
9	Read fault codes using OBD-II scanner from a test vehicle and interpret DTCs (Diagnostic Trouble Codes).	
10	Simulation of cruise control system using MATLAB/Simulink.	
11	Design and test of a closed-loop braking system model to study ABS principles.	
12	PID controller tuning for an automotive load system using Arduino or MATLAB.	
13	Analysis of motor drive integration with ECU for a small-scale electric vehicle platform.	
14	Battery Management System (BMS) simulation and cell balancing logic testing using MATLAB or Simulin	k.
15	Demonstration of regenerative braking using motor-generator test bench.	
Course	outcome: After completion of the course, the student will be able to	
CO 1	Describe the fundamental principles and scope of automotive mechatronics, identifying key components and current trends in the automotive industry.	K2
CO 2	Explain the working principles and selection criteria of various sensors and actuators used in automotive applications.	K2
CO 3	Illustrate the architecture of automotive ECUs and apply knowledge of in-vehicle communication protocols such as CAN and LIN for diagnostic purposes.	K2
CO4	Apply control system concepts to automotive applications such as cruise control, ABS, and drive-by-wire systems.	К3
CO 5	Demonstrate an understanding of mechatronic subsystems in electric and hybrid vehicles including battery management and regenerative braking.	K2

			B.T	ECH T	HIRD	YEAR					
Course Co	ode	BME0551						L	Т	Р	Credit
Course Ti	itle	Theory of Mach	nines Lab					0	0	4	2
Pre-requi	isites: E	ngineering Mechan	ics, Strength of	f Materials,	Engineeri	ng Drawii	ng			<u>, </u>	
			Coi	urse Cont	tents / Sy	/llabus					
Suggest	ed list	of Experimen	t								
Sr. No.	Nam	e of Experime	ent								
1	Study	of simple linkage m	nodels/mechanis	sms							
2		of inversions of fou									
3		of inversions of sin		er crank me	chanisms						
4	Experi	ment on cam and fo	ollower motion								
5	Experi	ment on static/dyna	mic balancing								
6	Experi	ment on gear trains									
7	Experi	ment on watt gover	nor								
8	Experi	ment on porter gov	ernor								
9	Experi	ment on proell gove	ernor								
10	Experi	ment on hartnell go	vernor								
11	Experi	ment on gyroscope									
12	Experi	ment on critical spe	ed of shaft								
13	Experi	ment on longitudin	al vibration								
14	Experi	ment on transverse	vibration								
Course or		After completion of and the relative mo					l their in	version	for the	specified	K2
		motion in a machin									
CO 2		and various motion y & dynamically of									K2
CO 3	Demons	strate the torque ana	alysis and meas	ure epicycli	ic gear rati	o on any	kind of o	on engii	ne or ma	achine shaf	t. K2
CO4		and the working pr			able to ider	ntify diffe	rent type	es of go	vernors	in actual	K2
CO 5		and the fundamenta		gyroscope d	& vibration	ns and ob	serve the	effect	of gyro	scopic coup	ole K2

	B.TECH THIRD YEAR		
Subject (Subject Code: BME0511 L T P: 3 0 0		
Subject N	Name: Factory Automation	Credits: 3	
Pre- re	quisites: NIL		
	Course Contents/Syllabus	<u> </u>	
Unit-1	Introduction to Factory Automation- Introduction to Automation in P Strategies of Automation, Basic Elements of an Automated System, A Levels of Automation, Flow Lines and Transfer Mechanisms, Fundamen	Advanced Automation Functions,	8 hours
Unit-2	Material Handling and Identification Technologies - Overview of Material Material Handling Systems, Material Transport Systems, Storage Stdentification Methods.	= : : : : : : : : : : : : : : : : : : :	8 hours
Unit-3	Automated Manufacturing Systems - Components, Classification a Systems, Manufacturing Cells, GT and Cellular Manufacturing, FN Implementation. Quality Control Systems: Traditional and Modern Quality Control Systems: Traditional Control Systems: Tra	AS, FMS and its Planning and	8 hours
Unit-4	Control Technologies in Automation: - Industrial Control Systems, Proc Manufacturing Industries, Continuous Versus Discrete Control, Comput		8 hours
Unit-5	Computer Based Industrial Control: - Introduction & Automatic Production Systems: LAN, Analog & Digital I/O Modules, SCADA System: Functional Requirements, Configurations.	=	8 hours
Course (Outcomes — After completion of the course, the student will be able	to	
CO1	Explain the principles and strategies of automation in production systadvanced functions, and levels of automation.	ems, including basic elements,	K2
CO2	Design and apply material handling systems.		K4
CO3	Analyze and implement automated manufacturing systems.		K3
CO4	Apply industrial control systems.		K3
CO5	Design and implement computer-based industrial control systems.		K4
Text Bo	ooks:		
Auto	mation, Production Systems, and Computer-Integrated Manufacturing, M	ikell P. Groover	
Manu	facturing Automation: Metal Cutting Mechanics, Machine Tool Vibratio	ns, and CNC Design, Yusuf Altintas	,
Indus	trial Automation: Handbook of the Practical Man, Frank Lamb		
Auto	mated Manufacturing Systems with PLCs, Hugh Jack		
Referen	nce Books:		
C	omputer Control of Machines and Processes, John G. Bollinger and Neil	A. Duffie	
Ir	dustrial Control Electronics: Applications and Design, J. Michael Jacob		
A	utomation and Control Systems, Frank Petruzella		
	NPTEL/You Tube/Web Link		
1. <u>htt</u>	ps://www.youtube.com/@realpars		
2. <u>htt</u>	ps://www.youtube.com/@Automationanywhere		
3. <u>htt</u>	ps://www.youtube.com/@Automationanywhere		

	B.TECH THIRD YEAR	R	
Subject Code: BME0513 L T P: 3 0 0 Subject Name: Industrial Robotics Credits: 3			
Pre- re	quisites: NIL		
	Course Contents/Syllab	us	
Unit-1	Introduction to Industrial Robotics, Introduction to Industrial Robots, Robotic Standards, Types of robots, Selection of robots, Robo & Specification of industrial Robots, Robot feedback controls: Point to p control, Control system for robot joint, Adaptive control, Types of Operation and programming, Economics of robotics, Workcell design p Robot installation, peripheral devices of robot.	t Classifications, Configuration oint control and Continuous path end effectors with application,	8 hours
Unit-2	Kinematics of Robots-Direct Kinematics link, Robot coordinates system, D-H Representation, Geometric transfor for articulated manipulator, SCARA Robot. Inverse Kinematics Need of inverse kinematics, inverse kinematics for articulated man singularities, Robot reachability and dexterity measures, Tool configurations.	ipulator, Multiple solutions and	8 hours
Unit-3	Dynamics of Robots- Dynamics Introduction to Robot dynamics, Static forces and torques in robot mar and payload considerations, Lagrange's equation kinetic and potential e		8 hours
Unit-4	Trajectory Planning & Machine Vision- Fundamentals of trajectory planare planning, Point-to-point motion vs. continuous path motion, Interpretable, Path constraints and optimization, Motion profiles (trapezoidal, Selection and avoidance strategies, Multi-point path planning. Machine vision Machine vision fundamentals for robotics, Camera types and selection, Camera processing basics for robotics, Object detection and recognition, For Vision-guided robot applications, Pick and place from vision, Visual serinspection systems, Bin picking applications, Sensor fusion and multi-serinspections.	Camera calibration concepts, voing concepts, Quality	8 hours
Unit-5	Programming & Robot Operating System- Introduction to robot programming, Lead-through programming, Textual programming langual syntax, Programming motion commands, I/O handling in robot programs operations, Subroutines and modularity in robot programming, ROS architecture and philosophy, ROS concepts: nodes, topics, services, a communication pattern, Workspace setup and package management, Rofframes and transformations using TF, ROS-Industrial framework, Interpretation in ROS, Creating custom ROS packages, Deployment of ROS	ages, Robot program structure and s, Program flow control and logical and actions, Publisher-subscriber bot modeling in ROS, Coordinate egration with commercial robots, gation and manipulation, Sensor	8 hours
Course	Outcomes –		
CO1	Identify and describe various industrial robot types and their application		К3
CO2	Understand robot kinematics concepts and apply them to real-world s	scenarios.	K5
CO3	Apply basic dynamics and control principles to robotic systems.		K5
CO4	Develop trajectory planning strategies and implement vision-based ap	oplications.	K6
CO5	Utilize robot simulation tools and implement applications using ROS	_	K6

"Industrial Robotics Technology programming and Applications", McGraw-Hill, M.P. Groover, M. Weiss, R.N. Nagel, and N.G. Odrey

Robotics: Fundamental Concepts and Analysis by, Oxford University Press, Ashitava Ghosal

"Robotics and Control", TMH Publications, R.K. Mittal and I.J. Nagrath,

"Fundamentals of Robotics Analysis and Control", PHI Learning, Robert J. Schilling,

Learning ROS for Robotics Programming, Packt Publishing, 2nd Edition (2015), ISBN: 9781783987443., Aaron Martinez and Enrique Fernández,

Reference Books:

Robotic Engineering: An Integrated Approach, Pearson Education, 1st Edition (2003), ISBN: 9788120325124., Richard D. Klafter, Thomas A. Chmielewski, and Michael Negin

Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 1st Edition (2017), ISBN: 9781107156302., Kevin M. Lynch and Frank C. Park

Probabilistic Robotics, and Dieter Fox, MIT Press, 1st Edition (2005), ISBN: 9780262201629., Sebastian Thrun, Wolfram Burgard

Links: NPTEL/You Tube/Web Link

Industrial Robotics and Automation - Course Introduction

Robotics by Prof D K Pratihar

Introduction to Robotics

Programming for Robotics (ROS) Course 1

	B.TECH THIRD YEAR		
Subject	Code: BME0512	LT P: 300	
Subject	Name: Automotive Engineering	Credits: 3	
Pre- re	quisites: NIL		
	Course Contents/Syllabus		
	Introduction to Automotive Engineering- Introduction to Automobil	le Engineering: Definition, history,	
	and importance of automobiles in modern transportation.		
	Classification of Automobiles: Based on purpose, fuel type, drive type, a	nd body style (e.g., passenger cars,	
	commercial vehicles, electric vehicles).	, , , , , , , ,	
Unit-1	Vehicle Configurations: Front-engine, rear-engine, mid-engine layor AWD/4WD.	outs; drive types – FWD, RWD,	8 hour
	Introduction to Vehicle Dimensions and Terminology: Wheelbase,	track width ground clearance	
	approach/departure angles, etc.	and the state of t	
	General Layout of an Automobile: Overview of main systems powertr	ain chassis suspension braking	
	steering, electrical, and body components.	am, chassis, suspension, traking,	
	I.C. Engines Vehicles- Introduction to I.C. Engines: Basic principles a	nd working of internal combustion	8 hour
	engines; classification – spark ignition (SI) and compression ignition (CI	•	
	Engine Types and Configurations: 2-stroke vs 4-stroke engines, inlin		
	water-cooled engines.		
TI:4 2	Main Components of I.C. Engines: Engine block, piston, crankshaft,	connecting rod, camshaft, valves,	
Unit-2	cylinder head, flywheel.		
	Engine Systems Overview: Fuel supply system (carburetor, fuel inject	ion, common rail direct injection).	
	Ignition system (battery ignition, magneto, spark plugs). Cooling system (radiator, thermostat, coolant, water	
	pump). Lubrication system (wet sump, dry sump, oil pump, oil filters).		
	Basic Engine Terminology: Bore, stroke, compression ratio, displacement		
	Electric and Hybrid Vehicles- Introduction to Electric Vehic	les (EVs): Evolution, need for	
	electrification, advantages and challenges of electric mobility.		
	Classification of Electric Vehicles: Battery Electric Vehicles (BEVs),		
	Plug-in Hybrid Electric Vehicles (PHEVs), and Fuel Cell Vehicles (FCV	•	
	Basic Components of an Electric Vehicle: Electric motor, battery		
Unit-3	converter, and electric drivetrain. Types of Electric Motors Used : Do Induction motors, Permanent Magnet Synchronous Motors (PMSM).	motors, Brusniess DC (BLDC),	8 hour
Omt-3	Battery Technologies: Lead-acid, Nickel-Metal Hydride (NiMH), 1	(ithium ion bottories structure	o nour
	working, advantages, limitations. Hybrid Powertrain Architectures: So		
	hybrids working principles and power flow.	eries, paraner, and series-paraner	
	Regenerative Braking and Energy Recovery: Concept and operation in	n EVs and hybrids.	
	regenerative Druming and Emergy receivery, concept and operation is	2 . 5 4114 11 5 61145.	
	Comparison with I.C. Engine Vehicles: Efficiency, emissions, rar		
	Comparison with I.C. Engine Vehicles : Efficiency, emissions, rar performance.		
		nge, maintenance, and overall	
	performance.	nge, maintenance, and overall	
	performance. Transmission and Braking System- Clutch Systems – Types of or	elutches: single plate, multi-plate,	
Unit-4	performance. Transmission and Braking System- Clutch Systems – Types of ocentrifugal, and diaphragm; basic operation and applications. Gearboxes – Manual (sliding mesh, constant mesh, synchromesh) and aud DCT); gear shifting mechanisms. Final Drive and Differential – Final Drive and Differential – Final Drive and Differential – Final Drive and Drive an	elutches: single plate, multi-plate, tomatic transmissions (CVT, AMT,	8 hour
Unit-4	performance. Transmission and Braking System- Clutch Systems — Types of ocentrifugal, and diaphragm; basic operation and applications. Gearboxes — Manual (sliding mesh, constant mesh, synchromesh) and aud DCT); gear shifting mechanisms. Final Drive and Differential — Fitransmission to wheels in various drivetrain layouts.	elutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power	8 hour
Unit-4	performance. Transmission and Braking System- Clutch Systems — Types of ocentrifugal, and diaphragm; basic operation and applications. Gearboxes — Manual (sliding mesh, constant mesh, synchromesh) and aud DCT); gear shifting mechanisms. Final Drive and Differential — Fitransmission to wheels in various drivetrain layouts. Drive Configurations — Overview of FWD, RWD, AWD, and 4WD systems.	elutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power	8 hour
Unit-4	Transmission and Braking System- Clutch Systems – Types of a centrifugal, and diaphragm; basic operation and applications. Gearboxes – Manual (sliding mesh, constant mesh, synchromesh) and aut DCT); gear shifting mechanisms. Final Drive and Differential – Fitransmission to wheels in various drivetrain layouts. Drive Configurations – Overview of FWD, RWD, AWD, and 4WD systuse cases.	clutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power stems with their advantages and	8 hour
Unit-4	Transmission and Braking System- Clutch Systems — Types of of centrifugal, and diaphragm; basic operation and applications. Gearboxes — Manual (sliding mesh, constant mesh, synchromesh) and aut DCT); gear shifting mechanisms. Final Drive and Differential — Fitransmission to wheels in various drivetrain layouts. Drive Configurations — Overview of FWD, RWD, AWD, and 4WD systuse cases. Modern Automotive Technologies- Automotive Electronics: Role of	elutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power stems with their advantages and Electronic Control Units (ECUs),	8 hour
	Transmission and Braking System- Clutch Systems — Types of of centrifugal, and diaphragm; basic operation and applications. Gearboxes — Manual (sliding mesh, constant mesh, synchromesh) and auto DCT); gear shifting mechanisms. Final Drive and Differential — Fitransmission to wheels in various drivetrain layouts. Drive Configurations — Overview of FWD, RWD, AWD, and 4WD systuse cases. Modern Automotive Technologies- Automotive Electronics: Role of Integrated Circuit Modules (ICMs), sensors, and actuators in controlling	elutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power stems with their advantages and Electronic Control Units (ECUs),	
Unit-4 Unit-5	Transmission and Braking System- Clutch Systems — Types of of centrifugal, and diaphragm; basic operation and applications. Gearboxes — Manual (sliding mesh, constant mesh, synchromesh) and aut DCT); gear shifting mechanisms. Final Drive and Differential — Fitransmission to wheels in various drivetrain layouts. Drive Configurations — Overview of FWD, RWD, AWD, and 4WD systuse cases. Modern Automotive Technologies- Automotive Electronics: Role of	clutches: single plate, multi-plate, tomatic transmissions (CVT, AMT, Function and construction; power stems with their advantages and Electronic Control Units (ECUs), g vehicle performance, safety, and	8 hour

Advanced Driver Assistance Systems (ADAS) – Features like Lane Departure Warning (LDW), Forward	
Collision Warning (FCW), Automatic Emergency Braking (AEB), Pedestrian Detection, Adaptive Cruise	
Control (ACC), Traffic Sign Recognition (TSR), and 360-degree cameras.	

Course Outcomes — After completion of the course, the student will be able to

CO1	Describe the fundamental principles of automobile engineering, including the general layout of a vehicle and the concepts of power, torque, and various resistances to motion.	K2
CO2	Explain the working principles, components, and performance characteristics of both Spark Ignition and Compression Ignition internal combustion engines, including their cycles, timing diagrams, emissions, and firing order.	K2
CO3	Explain EV, hybrid types, propulsion types, energy, and comparing their environmental and economic impacts against conventional vehicles.	K2
CO4	Explain the operation of different automotive transmission systems and braking systems	K2
CO5	Discuss ADAS, telematics, infotainment, sensors, ECUs, CAN bus, autonomous/connected concepts, advanced materials, IoT, and cybersecurity trends.	K2

Text Books:

Automobile Engineering , Newton and Steeds

Automobile Engineering, Ramakrishna, PHI, India.

Automobile Engineering, Kripal Singh

Reference Books:

Automotive Engineering- Hietner.

Automobile Engineering - Narang

Automobile Engineering – TTTI, Pearson India

Links: NPTEL/You Tube/Web Link

http://digimat.in/nptel/courses/video/107106088/L01.html

 $\underline{https://www.google.com/search?q=https://www.youtube.com/playlist%3Flist%3DPLwdnKv6Jags1bzjeJRhFTfVn1L7JmZJma}$

https://onlinecourses.nptel.ac.in/noc24_de03/preview

	B.TECH THIRD YEAR		
Subject (Code: BME0514	LT P: 300	
Subject Name: Automotive Engines Credits: 3			
Pre- re	quisites: NIL		
	Course Contents/Syllabus		
Unit-1	Engine Fundamentals, Engine types and their operation- classifications two stroke cycle Engine components, working principle of SI and parameters- Fuel – air and actual cycle analysis – Engine emissions – firing order	CI engines – Engine operating	8 hours
Unit-2	Induction And Ignition System-Carburettors – mixture requirements – wo – Requirements and objective of injection system – types of injection – Unit injector, common rail direct injection – Electronic fuel injection – lag. Types of injection nozzle. Spray characteristics. Split and Mulpneumatic governors. Ignition system- battery coil, magneto coil and Electronic fuel injection of the control o	Jerk and distributor type pumps, GDI, Injection timing, Injection Itiple injection. Mechanical and	8 hours
Unit-3	Combustion Of Fuels- Combustion in SI engine – Stages of combust pressure rise Abnormal combustion- combustion chambers – design of Thermodynamic analysis of SI engine combustion- Burned and Unburn process characterization- CI Engine – Importance of air motion – Swirl Stages of combustion. Delay period – factors affecting delay period. known indirect injection combustion chambers for diesel combustion.	pjectives and types Engine Knock ned mixture states – combustion , Squish and Tumble. Swirl ratio.	8 hours
Unit-4	Engine Cooling, Lubricating And Exhaust System- Cooling system – principle – Lubricating system- Function- types Lubricant Requirements supercharging. Types of super charger and turbo charger. Intercooler. Ma Modification of an engine for supercharging. Effect of supercharging on system- exhaust manifold – muffler types.	Necessity and limitation of atching of turbocharger.	8 hours
Unit-5	Engine Testing And Measurements- Engine testing and measuring equipperating variables that affect engine performance, efficiency and emission engine testing and related standards — use of transient dynamometer for emeasurement of indicated power-brake power- frictional power- efficient improve engine performance.	ion – Automotive and stationary engine testing. Engine power–	8 hours
Course	Outcomes — After completion of the course, the student will be able	to	
CO1	Understand engine types, components, and operating principles of SI analysis and emissions.	and CI engines, including cycle	K2
CO2	Analyze fuel delivery and ignition systems, including carburetors, inj mechanisms.		К3
CO3	Evaluate combustion processes in SI and CI engines and identify fact combustion chamber design.		K2
CO4	Explain engine cooling, lubrication, supercharging, turbocharging, an on performance.		K2
CO5	Conduct engine testing, measure performance parameters, and interpretent methods.	ret results using standard testing	K2
Text B	ooks:		
	rnal Combustion Engines, John B.Heywood,		
Inte	rnal Combustion Engine, M.L. Mathur and R.P.Sharma		
Inte	rnal Combustion Engines, V. Ganesan		
	nas Daalas		
Refere i	nced engine technology, Heinz Heisler		

Internal Combustion Engines, K. K. Ramalingm	
Internal Combustion Engine analysis and Practice, Obert, E.F.	
Links: NPTEL/You Tube/Web Link	
#1 course overview & classification of internal combustion engines part 01	
lec 1: introduction to engine systems and its types: a focus on ignition system	
lec 16: fuels and combustion (part i)	
noc19-ae02 lec 13 - cooling and exhaust system (lab session)	
ic engine- performance and testing of ic engine numericals	

	B.TECH THIRD YEAR		
Subject Co	ode: BNC0501	L T P: 200	
Subject Na	ame: Constitution of India	Credits: 2	
Pre- req	uisites: Computer Organization and Architecture		
	Course Contents/Syllabus		
Unit-1	NTRODUCTION AND BASIC INFORMATION ABOUT INDIAN Co- constitution law and constitutionalism, Historical Background of the Con- of India Act of 1935 and Indian Independence Act of 1947, Enforcen Constitution and its Salient Features, The Preamble of the Constitution, Fouties, Directive Principles of State Policy, Parliamentary System, Federa Amendment of the Constitutional Powers and Procedure, The historical parendments in India, Emergency Provisions: National Emergency, Presi	nstituent Assembly, Government nent of the Constitution, Indian undamental Rights, Fundamental Il System, Centre-State Relations, perspectives of the constitutional	8 hours
Unit-2	UNION EXECUTIVE AND STATE EXECUTIVE: Powers of Indian Sabha, Functions of Lok Sabha, Powers and Functions of the President, President with the United States, Powers and Functions of VicePreside Prime Minister, Judiciary – The Independence of the Supreme Court, Aceview, Public Interest Litigation, Judicial Activism, LokPal, Lok AyukAct 2013, State Executives – Powers and Functions of the Governor, Powers, Functions of State Cabinet, Functions of State Legislature, Subordinate Courts	Comparison of powers of Indian nt, Powers and Functions of the Appointment of Judges, Judicial cta, The Lokpal and Lok ayuktas owers and Functions of the Chief	8 hours
Unit-3	NTRODUCTION AND BASIC INFORMATION ABOUT LEGAL Sources of Law and the Court Structure: Enacted law -Acts of Parlia Common Law or Case law, Principles taken from decisions of judges of Court System in India and Foreign Courtiers (District Court, District Courts, Supreme Court). Arbitration: As an alternative to resolving disposition are in dispute can agree that this will instead be referred to arbitrative workplace.	ment are of primary legislation, onstitute binding legal rules. The onsumer Forum, Tribunals, High utes in the normal courts, parties	8 hours
Unit-4	NTELLECTUAL PROPERTY LAWS AND REGULATION TO INFOLAWS: Introduction, Legal Aspects of Patents, Filing of Patent Apprinfringement of Patents, Copyright and its Ownership, Infringement of Infringement, Regulation to Information, Introduction, Right to Inforfechnology Act, 2000, Electronic Governance, Secure Electronic Record Signature Certificates, Cyber Regulations Appellate Tribunal, Offences Technology Act.	blications, Rights from Patents, f Copyright, Civil Remedies for rmation Act, 2005, Information ds and Digital Signatures, Digital	8 hours
Unit-5	BUSINESS ORGANIZATIONS AND E-GOVERNANCE: Sole Trade Company's Act: Introduction, Formation of a Company, Memorane Association, Prospectus, Shares, Directors, General Meetings and Proc Governance and role of engineers in E-Governance, Need for reformed ensured that the level, Role of I.T. professionals in Judiciary, Problem of Alienatic creating hurdles in Industrial development.	dum of Association, Articles of eedings, Auditor, Winding up. E- igineering serving at the Union and	8 hours
ourse O	outcomes — After completion of the course, the student will be able t	О	
CO1	Identify and explore the basic features and modalities about In	dian constitution.	K1
CO2	Differentiate and relate the functioning of Indian parliamentar level.	y system at the center and state	K2
CO3	Differentiate different aspects of Indian Legal System and its re		K4
CO4	Discover and apply different laws and regulations related to en	·	K4
CO5	Correlate role of engineers with different organizations and go	vernance models	K4
Text Boo	oks:		

Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd

Granville Austin: The Indian Constitution: Cornerstone of a Nation (Classic Reissue), Oxford University Press.

Reference Books:

Madhav Khosla: The Indian Constitution, Oxford University Press

PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.

V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)

Links: NPTEL/You Tube/Web Link

	T 75 75 44 A	
Subject C	ode: BME0601 L T P: 3 1 0	
Subject N	lame: REFRIGERATION AND AIR CONDITIONING Credits: 4	
Pre- re	quisites: Thermodynamics, Basic Fluid Mechanics, Heat and Mass Transfer	
	Course Contents/Syllabus	
	Basics of refrigeration and Air Conditioning- Introduction: Brief history and need of refrigeration and	nir
Unit-1	conditioning, methods of natural refrigeration, unit of refrigeration, coefficient of performance, types a application of refrigeration.	nd 8 hours
	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.	
	Refrigerants and Vapour compression refrigeration Refrigerants: Classification, nomenclature, desiral	
T I 1/ 0	properties, secondary refrigerants, future industrial refrigerants, recent trends in refrigerants and its environmen impact.	_
Unit-2	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.	ı
Unit-3	Absorption and other refrigeration systems- Absorption Refrigeration System: Working Principal of vaporabsorption refrigeration system, Comparison between absorption & compression systems. practical NH3- H2 cycle, LiBr – H2O system and its working, Electrolux refrigeration system. Other refrigeration systems: Thermo-electric refrigeration system, Steam jet refrigeration system, Vortex tu	8 hours
	refrigeration system, Magnetic refrigeration system. Air conditioning- Psychrometry: Psychrometric properties and their definitions, Psychrometric chart, Different conditioning- Psychrometry: Psychrometric properties and their definitions, Psychrometric chart, Different conditioning- Psychrometry:	nt
Unit-4	Psychrometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling a heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roo 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	nd fs,
	system, Air Washers, Cooling towers.	
Unit-5	Refrigeration System Equipment : Compressors, Condensers, Expansion Devices and Evaporators, Elementa knowledge of transmission and distribution of air through ducts and fans. Application: Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water	0.5
	coolers, Comfort and Industrial air conditioning	
ourse (Dutcomes — After completion of the course, the student will be able to	
CO1	Illustrate the basic concepts of refrigeration and air conditioning systems and air refrigeration cycles	К3
CO2	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,	
CO3	Familiarize about the various equipment employed in refrigeration and air conditioning systems and grasp construction and working of vapour absorption system.	К3
CO4	Calculate the heating and cooling load requirements of a room and design it for human and industrial comfo	
CO5	Apply scientific and engineering principles to analyze and design of ducting and ventilation systems that rel to refrigeration and air conditioning.	ate K3
CO4	construction and working of vapour absorption system. Calculate the heating and cooling load requirements of a room and design it for human and industrial comfo Apply scientific and engineering principles to analyze and design of ducting and ventilation systems that rel to refrigeration and air conditioning.	

Refrigeration and Air-conditioning, Prentice Hall of India, Ramesh Arora
Refrigeration and Air Conditioning, New Age International Publisher, Manohar Prasad
Principles of Refrigeration, Pearson Education, Roy. J Dossat
Refrigeration and Air Conditioning, Prentice Hall of India Pvt. Ltd., Jordon and Prister
Reference Books:
Refrigeration and Air Conditioning, S.Chand Publication, R.S. Khurmi & J.K.Gupta,
Links: NPTEL/You Tube/Web Link
https://youtu.be/4mWsRUr0A7A
https://youtu.be/XO2PBDMEHfs
https://youtu.be/4w3Obp8ILpA
https://youtu.be/0BOVDcMxlyY
https://youtu.be/ExNJoT_2XeI

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1.3	Introd																													
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Module 1.10							latio	on,	Pro	odu	ctic	n, S	Sup	poi	rt o	of P	LM.													
1.11	Manag	ge De	sign	Dev	elop	mei	nt																							
1.12	Workir	ing W	ith C	AD	Dat	a																								
1.13	Manag	ge Fai	nily	Tabl	les																									
1.14	Change	ge Ma	nage	men	t																									
1.15	Exercis	ises o	n Ch	ange	Ma	ınag	gem	ent	-																					
1.16	Introdu	uction	ı to ^v	Vind	lchil	1 Bı	usin	iess	s A	dmi	inis	trati	ion	, Q)uiz	z-1														
Module 2.1	Collab Manag			rod	uct 1	Dev	elo	pm	ien	t: E	Engi	inee	erin	g V	Vau	ıltin	g, P	rod	uct !	Reu	ıse,	Sm	art P	arts,	Eng	neerin	ıg, (Chai	nge	
Module 2.2	Prototy			opm	ent,	Des	sigr	ı fo	or E	nvi	ron	mei	nt, `	Vir	rtua	al T	estin	ıg a	nd V	/ali	dat	ion,	Mar	ketin	g Co	llatera	ıl.			
2.3	Manag	ging (Obje	ets, C	Obje	ct T	`ype	es, a	and	l Oł	ojec	t A	ttril	but	tes															
2.4	Manag	ging I	Ooma	in P	olic	ies a	and	Ac	cces	ss C	Con	trol																		
2.5	Object	t Initi	aliza	tion	Rul	es C	IRs	s																						
2.6	Exercis	ises o	n Ob	ject	Initi	aliz	atic	on F	Rul	es (OIR	Ċs																		
2.7	Lifecy	cle T	emp	ate 1	Adm	inis	strat	tior	n																					
2.8	Exercis	ises o	n Lif	есус	ele T	em _j	plat	te A	Adn	nini	istra	ation	n,																	
Module 2.9	Digital	al Ma	nufa	ctur	ing	- P	\overline{LM}	I: D	Digi	ital	Ma	ınuf	act	uri	ng,	, Be	nefi	ts o	f Di	gita	ıl M	Ianu	factı	ıring	, Ma	nufact	uriı	ng th	ne Fi	rst-On
Module 2.10	Ramp	Up, V	Virtu	al Le	earn	ing	Cur	rve,	, M	anu	ıfac	turi	ng	the	e R	est,	Pro	duc	tion	Pla	nni	ng.								
2.11	Policy	Adm	inist	ratio	n Pı	efe	reno	ces																						
2.12	Exercis	ises o	n Po	licy .	Adn	ninis	stra	tior	n Pı	refe	eren	ices																		
2.13	Туре а	and A	ttrib	ite N	A ana	ager	nen	nt																						
2.14	Exercis	ises o	n Ty	pe aı	nd A	ttri ¹	bute	e M	1an:	age	me	nt																		
2.15	Workfl																													
2.16	Exercis	ises o	n Wo	orkfl	ow A	Adn	nini	istra	atio	n, (Qui	z-2																		
Module 3.1	Develo Corpor	oping	a P	LM	Stra									str	ate	gy,	imp	lem	enti	ng a	a Pl	LM	strate	egy,	PLM	I Initia	tive	es to	Sup	port
Module 3.2	Condu					essi	mer	nt:	Inf	ras	truc	cture	e A	sse	essr	men	t, A	sses	sme	ent (of (Curr	ent S	ystei	ns a	nd Apı	plic	atio	ns.	
3.3	Windel											_					, -									111		-		
3.4	Exercis		_					ata :	mo	del	S																			
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3.6	Exercises on Listeners
3.7	Form Processor, Validator and Filter
	Exercises on Form Processor, Validator and Filter,
M. 1 1. 2 0	Supply Chain Management: Basic Concepts and Introduction – Procurement, Supply Chain Management, Project
MOOTHE 19	Procurement and Subcontract Management.
Module 3.10	Vendor Management, Inventory Management.
3.11	Eclipse and debugger configurations
3.12	Exercises on Eclipse and debugger configurations
3.13	Windchill Customization Basics
3.14	The Windchill Development Environment
3.15	User Interface Customization
3.16	MCV Builders, Quiz-3
Module 4.1	Project Cost Management: Essentials of Cost Management, Cost Estimation, Cost Budget and Variance Analysis.
Module 4.2	Cost Monitoring and Control, Essentials of Project Cash Flows.
4.3	Managing Windchill Services
	Managing Windchill Properties
	File Vaulting and Replication Overview
4.6	Tuning Windchill Server
4.7	Windchill Backup and Recovery
4.8	Managing Log Files and Alerts,
	Quality & EHS Management: Defining Quality, Construction Project Quality, Quality Management System, 7 Quality
Module 4.9	Tools.
Module 4.10	Control Chart & Cost of Quality. Introduction to Occupational Health, Safety and Environment.
4.11	Windchill License Management
4.12	Daily System Monitoring Tasks
4.13	Weekly System Monitoring Tasks
4.14	Monthly System Monitoring Tasks
4.15	Setting Up the Client Environment
4.16	Miscellaneous System Enhancements, Quiz-4
Module 5.1	Project Risk Management: Risk Introduction, Risk Analysis.
Module 5.2	Risk Response Strategy and Implementation.
5.3	Revision and Doubt Clearing with Project Work
5.4	Revision and Doubt Clearing with Project Work
5.5	Revision and Doubt Clearing with Project Work
5.6	Revision and Doubt Clearing with Project Work
5.7	Revision and Doubt Clearing with Project Work
5.8	Revision and Doubt Clearing with Project Work
	Project Monitoring & Control: Introduction to Project Monitoring and Controlling, Analysis Techniques.
	Visualization Techniques, Elements of Control, Monitor and Control Schedule, Cost and Resources.
5.11	Project Work
5.12	Project Work
5.13	Project Work
5.14	Project Work
5.15	Project Work
5.16	Project Work, Quiz-5
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Course out	come: After completion of the course, the student will be able to
	· ·
	To integrate systematic approaches of innovative product lifecycle management using design thinking with an

CO 2	To develop ability to employ state-of-the-art technology in product and process development and be PLM proficient.	K3
CO 3	To develop skills to support product realization, including prototype, testing, validation and marketing.	К3
CO4	To introduce the latest trends and technology in digital manufacturing.	K3
CO 5	To familiarize with the concepts of PLM strategy and application.	К3
Link: NPTI	EL/ YouTube/ Faculty Video Link:	
https://youtu.	be/HN9GtL21rb4	
https://archiv	e.nptel.ac.in/courses/110/104/110104084/	
https://archiv	ve.nptel.ac.in/courses/110/104/110104084/	
https://archiv	e.nptel.ac.in/courses/110/104/110104084/	
https://youtu	.be/dcup4kRxSEs	

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Pre-requi	sites:	Basic	of me	chanic	s, fou	ındat	tiona	al kr	now	ledg	ge o	f A	I, ro	bot	ics,	IO	Гѕу	sten	ns, s	ensor	s, e	tc		ı			
-								Co	urs	e C	ont	ten	its ,	/ Sy	ylla	bus	S										
Suggest	ed lis	t of	Ехре	rime	ent																						
Sr. No.	Nar	ne o	f Exp	erin	nen	t																					
1.1	Study	y of Cı	t Sec	ions a	nd M	agne	etic s	sym	bols	s use	ed ii	n pr	neur	nati	c ci	rcui	its										
1.2	Opera	ation o	f a siı	igle ac	ting o	cylin	der																				
1.3	Opera	ation o	f a do	uble a	cting	cylii	nder	•																			
1.4	Impu	ılse pil	ot ope	ration	of sir	ngle	actii	ng c	ylin	nder																	
1.5	Main	ntained	pilot	operati	ion of	fsing	gle a	actin	ng c	ylin	der																
1.6	Opera	ation o	f sing	le acti	ng cy	linde	er us	sing	dua	al pr	essi	ure	(AN	ID)	val	ve											
1.7	Opera	ation o	f sing	le acti	ng cy	linde	er - (cont	troll	led f	ron	ı di	ffere	ent j	posi	itior	ıs u	sing	shu	ttle (OR)	valv	e				
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2.8	Apply actua	y OR I	ogic i	ising t	wo m	anua	al co	ntro	ols v	vith	rela	ay fo	or 10	orwa	ard	stro	ке (of a	dou	oie ac	eting	g cylii	nder	(use	rela	y for s	soleno
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3.1	RESI	P - Re	spirati	on, He	artbe	at se	enso	r.																			

Study of Agriculture based sensors such as:- Temperature, Humidity, Pressure Sensor, Soil Temperature, Soil Moisture,

	Rain sensor.						
3.3	Study of Healthy Environment based sensors such as:- PIR Motion sensor. Air quality sensor, Fire sensor, Gyroscope sensor, Gas sensors, Light sensors.	Accelerometer					
3.4	Study of various IoT components.						
4.1	Write a program to blink an LED using Arduino.						
4.2	Write a program to identify object distance using Ultrasonic sensor & Arduino Uno.						
4.3	Write a program to read temperature and humidity using DHT-11 & Arduino Uno.						
4.4	Write a program to read and display sensor value of MQ135 gas sensor using Arduino Uno.						
4.5	Write a program to connect LDR with Arduino Uno.						
4.6	Write a program to connect potentiometer with Arduino Uno.						
4.7	To interface motor using relay with Arduino and write a program to turn motor ON/OFF./						
4.8	To interface sensors to Arduino and display the sensor data.						
4.9	To interface sensor with Arduino and write a program to turn ON/OFF Solenoid valve when sensor data is of	letected.					
5.1	To interface sensor with Arduino and write a program to turn ON/OFF Linear Actuator when sensor data is detected.						
5.2	To interface Arduino to a Bluetooth Module and send sensor data to a smart phone using Bluetooth.						
5.3	Write a program to connect HC-05 Bluetooth with Arduino and controlling LED using BLYNK.						
5.4	Write a program to send data to ThingSpeak server using NodeMCU & DHT-11 sensor.						
5.5	Develop an IoT based Smart water flow system.						
5.6	Develop an IoT based smart lock system for Motorcycle/Car/Household door						
	utcome: After completion of the course, the student will be able to						
CO 1	Use and perform experiments based on Pneumatic Trainer kit	K2					
CO 2	Use and perform experiments based on Electro-Pneumatic trainer kit and Modular manufacturing system	K2					
CO 3	Gain knowledge of IoT sensors and Study various IoT components	K2					
CO4	Understand how to connect the controller, sensors and actuators for different applications	K2					
CO 5	Implement the IoT knowledge in different activities and projects.	K2					

		B.TECH THIRD YEAR							
Course C	ode	BME0651 L T P	Credit						
Course Ti	tle	REFRIGERATION AND AIR CONDITIONING LAB 0 0 2	1						
Pre-requ	isites: k	knowledge of Thermodynamics							
		Course Contents / Syllabus							
Suggest	ed list	of Experiment							
Sr. No.	Nam	ne of Experiment							
1	Exper	iment on refrigeration test rig and calculation of various performance parameters.							
2	To stu	dy different types of expansion devices used in refrigeration system.							
3	To stu	dy different types of evaporators used in refrigeration systems.							
4		To study basic components of air-conditioning system.							
5	Experi	iment on air-conditioning test rig & calculation of various performance parameters.							
6	Experi	iment on water cooling tower to evaluate its performance							
7	-	of window air conditioner.							
8		dy different types of compressors used in refrigeration and air conditioning systems.							
9		of a central air conditioning plant and its detailed study.							
10		of cold-storage and its detailed study.							
11	-	iment on Desert coolers.							
12	To stu	dy different types of condensers used in refrigeration and air conditioning systems.							
	utcome	After completion of the course, the student will be able to							
CO 1	Demon	strate practical understanding of Simple vapour compression refrigeration system	K2						
CO 2		strate working understanding of types of evaporators, condensers, compressors and expansion devarefrigeration system.	rices K2						
CO 3	Analyz	te and calculate the performance of refrigeration test rig.	K2						
CO4	Calcula	ate coefficient of performance of air-conditioning test rig.	К3						
CO 5	Demon	strate the complete working of window air conditioner.	K2						

	B.TECH THIRD YEAR		
Subject (Code: BME0611 L T	P: 3 0 0	
Subject N	Name: Smart Manufacturing Cr	edits: 3	
Pre- re	quisites: Basic manufacturing processes, foundational knowledge of AI, robotics and IOT	systems.	
	Course Contents/Syllabus		
Unit-1	 Introduction to IIoT system and its architecture. Sensor Technologies and Data Acquisition Systems Cloud computing, Edge computing and Fog computing IIoT Applications in Forming: Real-time Process Monitoring and Adaptive Control IIoT Applications in Casting: Mold Monitoring and Defect Prediction IIoT Applications in Machining: Tool Condition Monitoring and Predictive Maintenance IIoT Applications in Assembly: Smart Assembly Lines and Error-Proofing IIoT Applications in Additive Manufacturing: Process Monitoring and Quality Control 		8 hours
Unit-2	 2.1. AI and ML Fundamentals for Manufacturing Applications 2.2. Supervised, Unsupervised and Reinforcement Learning in Manufacturing 2.3. AI Applications in Forming: Predictive Modeling for Process Parameters and Defect Prediction 2.4. AI Applications in Casting: Optimization of Casting Parameters and Microstructure Prediction 2.5. AI Applications in Machining: Adaptive Control and Machining Parameter Optimization 2.6. AI Applications in Assembly: Defect Detection and Quality Inspection 2.7. AI Applications in Additive Manufacturing: Process Parameter Optimization and Part Quality Prediction 2.8. Deep Learning for Manufacturing Process Vision Systems 	iction	8 hours
Unit-3	 3.1. Digital Twin Fundamentals and Architecture 3.2. Types and components of Digital twins 3.3. Data Integration and Model Synchronization 3.4. Digital Twins in Forming: Virtual Process Design and Real-time Process Control 3.5. Digital Twins in Casting: Mold Design Optimization and Solidification Simulation 3.6. Digital Twins in Machining: Virtual Machining and Fixture Design 3.7. Digital Twins in Assembly: Assembly Sequence Planning and Virtual Commissioning 3.8. Digital Twins in Additive Manufacturing: Build Process Simulation and Part Performanc 3.9. Factory-level Digital Twins for Production Planning and Control 	e Prediction	8 hours
Unit-4	 4.1. Introduction to Applied Industrial Robotics, types and historical development. 4.2. Collaborative Robots (Cobots), Safety, Programming and Applications 4.3. Autonomous Mobile Robots (AMRs) and Automated Guided Vehicles (AGVs) 4.4. Robotics in Forming: Automated Loading/Unloading and In-process Adjustments 4.5. Robotics in Casting: Mold Preparation, Pouring, and Finishing Operations 4.6. Robotics in Machining: Robot-assisted Machining and Automated Workpiece Handling 4.7. Robotics in Assembly: Flexible Assembly Systems and Human-Robot Collaboration 4.8. Robotics in Additive Manufacturing: Multi-axis 3D Printing and Hybrid Manufacturing 4.9. End Effector Design for various manufacturing applications 		8 hours
Unit-5	 5.1. Augmented/Virtual Reality (AR/VR): Principles and Manufacturing Applications 5.2. AR/VR Applications: Design Visualization, Training, and Maintenance Support 5.3. Blockchain Technology: Fundamentals and Distributed Ledger Systems 5.4. Blockchain Applications: Supply Chain Traceability and Digital Product Passports 5.5. Big Data Analytics: Introduction, Architecture and Manufacturing Data Pipelines 5.6. Big Data Applications: Production Optimization and Quality Control 5.7. Manufacturing Execution Systems (MES): Integration with Shop Floor Systems 5.8. Cybersecurity for Smart Manufacturing: Threat Assessment and Mitigation, Protect Manufacturing Infrastructure 	ting Critical	8 hours
Course (Outcomes — After completion of the course, the student will be able to		
CO1	Understand the role of IIoT sytems in manufacturing.		K2
CO2	Learn and apply concepts of AI and ML in the manufacturing processes.		K2
CO ₃	Understand the importance and role of digital twin technology in industry.		K2

CO4	Understand the functions of robotics and automation in manufacturing	K2
CO5	Gain knowledge over other emerging technologies that helps making manufacturing smart.	K1
Text Bo	ooks:	
ndustry 4.0:	The Industrial Internet of Things. Apress.	
Automation,	Production Systems, and Computer-Integrated Manufacturing. Pearson.	
Deep Learni	ng. MIT Press.	
Automated I	Manufacturing Systems with PLCs, Hugh Jack	
Referen	ace Books:	
Digital Twin	: Manufacturing Excellence through Virtual Factory Replication. White Paper.	
	: Manufacturing Excellence through Virtual Factory Replication. White Paper. adbook of Robotics. Springer.	
Springer Ha		
Springer Han	ndbook of Robotics. Springer.	
Springer Han Cloud-Based Links:	ndbook of Robotics. Springer. Cyber-Physical Systems in Manufacturing. Springer	
Springer Han Cloud-Based Links:	ndbook of Robotics. Springer. Cyber-Physical Systems in Manufacturing. Springer NPTEL/You Tube/Web Link	
Springer Han Cloud-Based Links: http	ndbook of Robotics. Springer. Cyber-Physical Systems in Manufacturing. Springer NPTEL/You Tube/Web Link ps://youtu.be/wspWyKbqY7A?si=FXNQkOtJfxpWMk8D	

https://youtu.be/lzktCpbxT8g?si=19auukK6XMQMvJ7M

Subiect (Code: BME0613	LTP:300	
	Name: Machine Learning in manufacturing	Credits: 3	
	quisites: Statistics & Probability		
	Course Contents/Syllab	NG.	
Unit-1	Introduction to Machine Learning, Types of Machine Learning, and Apengineering, Designing a Learning System, Performance Measures fo Learning, application of machine learning in manufacturing.		8 hours
Unit-2	Supervised Learning, Classification, Regression Analysis and its Ty Bayesian Decision Theory, Naïve Bayes Classifier, Bayes Optimal Class and Variance, Support Vector Machines, Types of Support Vector K Kernel, Gaussian Kernel, Issues in SVM, use of regression and classification	Sifier, evaluating an Estimator: Bias Kernel (Linear Kernel, Polynomial	8 hours
	Decision Trees: Basics of Decision Tree, Issues in Decision tree learning, and Entropy.	ID3 Algorithm, Information gain	
Unit-3	Unsupervised Learning: Introduction to Unsupervised Learning, Cluster KNN, Expectation-Maximization Algorithm, Dimensionality Reduction Independent Component Analysis, Multidimensional Scaling, Implementation and analysis of clustering in manufacturing.	: Principal Components Analysis, Linear Discriminant Analysis,	8 hours
	Introduction to Neural Networks: ANN, RNN, Perceptron, The Back F		
	Convolution Neural Networks, Types of Layers of CNN, case stud	ly: Neural network use to builds	
Unit-4	autonomous manufacturing system		8 hours
	Evolutionary Computing, Simulated Annealing, Random Search, Downloptimization, ant colony optimization, bee colony optimization.	nill Simplex Search, Swarm	
	Introduction to Neural Networks: ANN, RNN, Perceptron, The Back F	Propagation Algorithm, Concept of	
	Convolution Neural Networks, Types of Layers of CNN, case stud	ly: Neural network use to builds	
Unit-5	autonomous manufacturing system		8 hours
	Evolutionary Computing, Simulated Annealing, Random Search, Do optimization, ant colony optimization, bee colony optimization.	ownhill Simplex Search, Swarm	
Course	Outcomes –		
CO1	Understanding utilization and implementation proper machine learnin	g algorithm.	K2
CO2	Understand and apply the basic supervised machine learning algorithm	• •	К3
CO3	Understand and apply the basic unsupervised machine learning algori	ithms.	K3
CO4	Understand and implement various neural network models.		K3
CO5	Understand and apply the reinforcement learning algorithms.		K3
Text B	ooks:		
Mad	hine Learning: A Constraint-Based Approach, Morgan Kaufmann. 2017		
	hine Learning: The New AI, MIT Press-2016		
"Ma	chine Learning", McGraw-Hill, 2010		

Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press.

Links: NPTEL	/You Tube/Web Link
https://www.	youtube.com/watch?v=P0fJ0ECTMRY&list=PLEq2lkfJdUyYrDeEyYQkI8tFH9dwypuxj&index=61
https://www	.youtube.com/watch?v=EthRahJIUhE&list=PLEq2lkfJdUyYrDeEyYQkI8tFH9dwypuxj&index=62
https://www.	youtube.com/watch?v=OF3P64JQgOs&list=PLEq2lkfJdUyYrDeEyYQkI8tFH9dwypuxj&index=63
https://www	.youtube.com/watch?v=A8K_RykoWFc&list=PLEq2lkfJdUyYrDeEyYQkI8tFH9dwypuxj&index=65
https://www	.youtube.com/watch?v=JJ6hR9Itj4&list=PLEq2lkfJdUyYrDeEyYQkI8tFH9dwypuxj&index=64

	B.TECH THIRD YEAR	<u> </u>	
Subject (Code: BME0612	LT P: 300	
Subject I	Name: Automotive Transmission & Suspension Systems	Credits: 3	
Pre- re	quisites: Basic knowledge of Mechanics of Machines and Automotive	e Engineering	
	Course Contents/Syllabus	3	
Unit-1	Function and necessity of transmission in automobiles; Classification of automatic, CVT, etc.); Layout of power transmission from engine to whe Multi-Plate Clutch, Cone Clutch, Centrifugal Clutch, Diaphragm comparison of clutches; Torque Converters and Fluid Couplings; considerations, and heat dissipation.	els; Clutches: Single Plate Clutch, Clutch Working principle and	8 hours
Unit-2	Gearbox types: Sliding mesh, Constant mesh, Synchromesh gear multiplication; Epicyclic gear trains: working and gear calculations automatic transmissions; Overview of CVT and Dual Clutch Transmissions, vs. automatic transmissions in terms of performance, efficiency, and con-	s; Construction and working of ons (DCT); Comparison of manual	8 hours
Unit-3	Propeller shafts: construction and balancing; Universal joints and slip jo slip, Locking; Rear and front axle layouts; Working of 4WD and AWD of gearbox and differential; Transfer case, torque split control, and cross	oints; Differentials: Open, Limited O systems; Transaxles: integration	8 hours
Unit-4	Suspension objectives: ride comfort, stability, load isolation; Types of stand independent; Springs: Leaf, Coil, Torsion bar, Air springs; Suspensi dynamics: Camber, Caster, Toe-in and Toe-out, Kingpin inclination; Shehydraulic, gas-charged, twin-tube, mono-tube; Suspension kinematics and the stability of the s	on geometry and vehicle ock absorbers and dampers: and effect on handling.	8 hours
Unit-5	Active Suspension Systems: components and working; Semi-active and pneumatic and electro-pneumatic suspension systems; Electronic contro (accelerometers, position sensors), Actuators, ECU (Electronic Control Strut, Multi-link suspension; Introduction to ride and handling simulatio	l systems for suspension: Sensors Unit); Case Studies: McPherson	8 hours
Course	Outcomes — After completion of the course, the student will be able	to	
CO1	Explain transmission system types, clutch applications, and torque co	onverter functions.	K2
CO2	Analyze gear train layouts, gear ratios, and compare manual vs. autor		K4
CO3	Describe propeller shafts, differentials under dynamic conditions, and	•	K2
CO4	Identify suspension types, their geometry impact on vehicle dynamic		K2
CO5	Distinguish suspension types, understand electronic control systems, applications.	and analyze advanced suspension	K4
Text B	ooks:		
Aut	omobile Engineering Vol. I & II, Standard Publishers		
	omobile Engineering, Satya Prakashan		
	ranced Vehicle Technology, Butterworth-Heinemann		
	nce Books:		
Autor	notive Suspension and Steering Systems, Delmar Cengage		
Autor	notive Mechanics, Tata McGraw Hill		
Trans	mission, Chassis and Related Systems, Butterworth-Heinemann		
Links:	NPTEL/You Tube/Web Link		
https://onl	inecourses.nptel.ac.in/noc24_de03/preview		
https://arcl	nive.nptel.ac.in/courses/107/106/107106088/		

http://kcl.digimat.in/nptel/courses/video/107106088/L66.html

 $\underline{https://www.youtube.com/watch?v=GinzMttVE1M}$

	LT P: 300									
Subject (Code: BME0614 L 1 P: 3 U U									
Subject I	Name: Automotive Manufacturing and Materials Credits: 3									
Pre- re	quisites: Foundational knowledge in mechanical engineering and materials science.									
	Course Contents/Syllabus									
	Overview of automotive manufacturing;									
	Evolution of automotive manufacturing technologies;									
Unit-1	Manufacturing systems in the automotive industry;	8 hours								
UIIIt-1	Materials used in automotive manufacturing;	o nours								
	Process selection criteria;									
	Automation and Robotics in automotive manufacturing.									
	Chassis & Frame: Steel/aluminum; stamping, welding, hydroforming, coating									
	BIW: Steel/aluminum/composites; stamping, welding, bonding									
	Engine & Powertrain: Cast iron/aluminum; casting, forging, machining, heat treatment									
Unit-2	Transmission: Alloy steel/aluminum; gear cutting, broaching, forging									
	Suspension: Steel/aluminum/rubber; forging, heat treatment, molding									
	Brakes: Cast iron/aluminum; casting, sintering, machining									
	Steering: Steel/aluminum; machining, casting, molding, assembly									
	Fuel & Exhaust: Steel/plastic/ceramic; forming, welding, molding, coating									
Unit-3	Electrical Systems: Copper/plastic; harnessing, PCB soldering, molding	8 hours								
CIIIt-3	Interior: ABS/foam/leather; molding, stitching, welding									
	Exterior: Sheet metal/plastics; stamping, injection molding, painting									
	ehicle Assembly and Integration:									
	Assembly stages: Body-in-white (BIW), Paint Shop, Trim, Chassis, and Final Assembly									
	Subsystem assembly: engine, transmission, suspension, electricals, interiors, HVAC									
Unit-4	Tools and equipment: jigs, fixtures, robots, fastening techniques (welding, adhesives, bolts, rivets)	8 hours								
	Assembly Line Design and Optimization:	0 110 111								
	Types of lines: Manual, Semi-automated, fully automated;									
	Takt time, line balancing, synchronous and asynchronous flow systems									
	Ergonomics, material handling, and conveyor systems in line design									
	Automation and Smart Manufacturing:									
	Use of robotics and AGVs in body and final assembly;									
	Industry 4.0 tools: sensor networks, PLCs, IoT, and AI integration;									
Unit-5	Predictive maintenance and real-time data monitoring in smart factories; Quality Assurance and Testing:	8 hours								
	In-line and end-of-line inspection techniques;									
	Functional testing: emissions, brakes, water leak, roadworthiness;									
	Statistical Process Control (SPC), Six Sigma, and defect management									
	Outcomes — After completion of the course, the student will be able to									
CO1	Understand the fundamentals of automotive manufacturing, its history, and the materials involved.	K2								
CO2	Identify materials and manufacturing processes used in structural and mechanical vehicle systems.	K2								
CO ₃	Explain manufacturing techniques for auxiliary, electrical, interior, and exterior vehicle systems	K2								
CO4	Describe the stages of vehicle assembly and integration, and explain the design and optimization of various types of automotive assembly lines.	K2								
CO5	Analyze the role of automation, Industry 4.0 tools, and quality assurance techniques in enhancing vehicle manufacturing efficiency and reliability.	K4								

- "Manufacturing Processes for Engineering Materials"
- "Materials Science and Engineering: An Introduction"
- "Principles of Materials Science and Engineering"

Reference Books:

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley. (2015),

Manufacturing Engineering and Technology, Pearson. (2014),

Manufacturing Processes for Engineering Materials, Pearson. (2019),

Fundamentals of Engineering Materials, McGraw-Hill. (2014),

Engineering Materials 1: An Introduction to Properties, Applications, and Design, Butterworth-Heinemann. (2012),

Links: NPTEL/You Tube/Web Link

https://archive.nptel.ac.in/courses/107/106/107106088/

https://archive.nptel.ac.in/courses/112/107/112107219/

https://archive.nptel.ac.in/courses/112/103/112103293/

 $\underline{https://www.youtube.com/watch?v=2rxbxNem1iI\&list=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ}$

https://www.youtube.com/watch?v=KMcsjCXfLQw&list=PLyAZSyX8Qy5Am_2StOOQ5vCUE3VIcAenE

	B.TECH THIRD YEAR			
Subject Code: BNC0601		LT P: 200	L T P: 200 Credits: 2	
		Credits: 2		
Pre- re	quisites:			
	Course Contents/Syllabus	<u> </u>		
Unit-1	SOCIETY STATE AND POLITY IN INDIA: 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.		8 hours	
Unit-2	INDIAN LITERATURE, CULTURE, TRADITION, AND PRACTICES: 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		8 hours	
Unit-3	INDIAN RELIGION, PHILOSOPHY, AND PRACTICES: 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.		8 hours	
Unit-4	SCIENCE, MANAGEMENT AND INDIAN KNOWLEDGE SYSTEM: 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		8 hours	
Unit-5	CULTURAL HERITAGE AND PERFORMING ARTS: 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.		8 hours	
Course	Outcomes — After completion of the course, the student will be able	to		
CO1	Understand the basics of past Indian politics and state polity		K1	
CO2	Understand the Vedas, Upanishads, languages & literature of	Indian society.	K2	
CO3	Know the different religions and religious movements in India.		K4	
CO4	Identify and explore the basic knowledge about the ancient hi science & technology, and ayurveda.	story of Indian agriculture,	K4	
CO5	Identify Indian dances, fairs & festivals, and cinema		K4	
Text B	ooks:			
	raramakrishna (Ed.), Cultural Heritage of India-Course Material, Bh	aratiya Vidya Bhavan, Mumbai, !	5th	
	aliyan, Indian Art and Culture, Oxford University Press, India			
	n Singhania, Indian Art and Culture: for civil services and other cor w Hill	npetitive Examinations,3rd Editio	on,Mc	
Refere	nce Books:			
	la Thapar, Readings In Early Indian History Oxford University Press			
Basha	am, A.L., The Wonder that was India (34th impression), New Delhi,	, Rupa & co.		