







Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur (An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTION & SYLLABI

Programme: Mechanical Engineering

Scheme of Instructions: Third Year B.Tech. In Mechanical Engineering Semester-VI (As Per NEP 2020)

Sr.	Course		The Tear Bife		Contact Hrs / Wk			Exam Scheme			neme		
No.	Category	Course Code	e Course Title		L	P	Hrs	Credits	CT-1	CT-2	CA	ESE	TOTAL
1	PCC	BME33601	Internal Combustion Engine	T	3	-	3	3	15	15	10	60	100
2	PCC	BME33602	Mechatronics & Robotics	T	3	-	3	3	15	15	10	60	100
3	HSSM	BME33603	Principles of Industrial Management	T	2		2	2	7	8	5	30	50
4	VSEC	BME33604	Modelling And Simulation On Software	P	-	4	4	2		,-	25	25	50
5	PEC	BME33605-08	Programme Elective-II	T	4	-	4	4	15	15	10	60	100
6	PEC	BME33609-12	Programme Elective-III	T	4	-	4	4	15	15	10	60	100
7	MDM	BÇS33601	Artificial Intelligence	Т	2	-,	2	2	7	8	5	30	50
8	PCC	BME33613	Internal Combustion Engine Lab	P	-	2	2	1	-	-,	25	25	50
9	PCC	BME33614	Mechatronics & Robotics Lab	P	-	2	2	1	-	-	25	25	50
		=	Total		18	8	26	22	74	76	125	375	650

L-Lecture

SL-Self Learning

P-Practical

NHL-Notional Hrs/Wk(Total Notional Hrs)

CT1-ClassTest1 CT2-ClassTest2

TA/CA-Teacher Assessment Continuous Assessment

FSE-End Semester Evamination (For Laboratory End Semester Performance)

	OTZ Classicstz	LO	L-Liid Seillestei	Examination (For L	abbiatory End Sch	icsici i criorinance)	
Course Category	PCC (Programme Core Courses)	PEC (Programme Elective Courses)	(MDM) Multidisciplin ary Minor	OEC (Open Elective courses from other discipline)	VSEC (Vocational and Skill Enhancement Course)	HSSM (Humanities Social Science and management) (VEC/IKS/AEC)	FP/CP/OJT/RM/ Project (Experimental Learning Courses)
Credits	8	8	2	-	2	2	
Cumulative Sum	40	12	11	8	8	14	2

PROGRESSIVE TOTAL CREDITS: 106+22=128

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Df. Premanand Naktode

May,2025

Date of Release

1.00

Version

Applicable for AY2025-26 Onwards

Principal Principal GPCET, Nagpur

Programme: Mechanical Engineering
List of Program Electives offered By Mechanical Department (NBA Accredited)

Program Elective-I	Program Elective-II	Program Elective-III	Program Elective-IV	Program Elective-V
Semester V	Semester VI	Semester VI	Semester VII	Semester VIII
BME33504: Industrial Economics and Management	BME33605: Hydraulic and Pneumatic Systems	BME33609: Finite Element Method	BME34704: Total Quality Management	BME34803: Material Handling System
BME33505: Computer Aided Design	BME33606: Mechanical Measurement and Metrology	BME33610: Advanced Manufacturing Techniques	BME34705: Finite Element Analysis	BME34804: Computer Integrated Manufacturing
BME33506: Automotive System	BME33607: Automotive maintenance and Industrial Safety	BME33611: Operation Research	BME34706: Design of Mechanical drives	BME34805: Renewable Energy System
BME33507: Smart Manufacturing	BME33608: Control System Engineering	BME33612: Industrial Robotics	BME34707: Advanced Mechanical Vibration	BME34706: Composite and Nano Materials

Marie Divisione		helis	May, 2025	1.00	Applicable for AY 2025-26 Onwards
hanical Engineering (NBA Academics ulsiramji Gaikwad Patil College at the same of the same	Vice Principal	Principal	Date of Release	Version	
ulsiramji Gaikwad Patil College Wastramji Gaikwad-Pa	Ur. Fragati Patil	Dr. Promonand No.	.A. al -		

Engineering & Technology, Nagpur

imji Gaikwad Patil Collegeofege Of Engineering Vice-Principal Engineering, Nagpur and Technology, Nagpulsiramji Gaikwad Patil College of

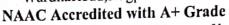
Principal TGPCET, Nagpur

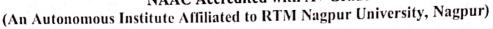


UnitIV

Tulsiramji Gaikwad-Patil College of Engineering and Technology

WardhaRoad, Nagpur-441108







Third Year (Semester-VI) B. Tech. Mechanical Engineering BME33601: Internal Combustion Engine **Examination Scheme Teaching Scheme** 30 Marks CT 3Hr/Week Lectures 10 Marks CA **Tutorials** 60 Marks ESE 3 **Total Credits** 100 Marks Total Duration of ESE:03Hrs **Course Objectives:** To learn the concept of IC Engine To understand the concept of fuel supply and engine lubrication To apply the basic knowledge of ignition in IC engine To analyze the testing and performance of IC engine 4 To understand recent advances in IC engine Hours **Course Contents** Introduction: Introduction, Engine Classification, components of I. C. Engines, Two stroke SI and CI (9) engines, Four stroke SI and CI engines, Comparison of SI and CI Engines, valve and port UnitI timing diagram. Advantages and disadvantages, applications. Fuels and its supply system for IC Engines: Important qualities of IC engine fuels, rating of fuels, Carburetion, mixture requirement for different loads and speeds, simple carburetor and its working, types of carburetors, MPFI, types of injection systems in CI engine, fuel pumps and injectors, types of nozzles, spray (9) formation. UnitII Engine cooling and lubrication: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison, Air cooling, Liquid cooling, types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems, Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers Ignition and Combustion in IC Engines: Function of Ignition system, Battery and Magneto Ignition system, Electronic Ignition system, Spark plug and its types, Firing order, (9) Unit III Types of combustion chambers in SI and CI engines, Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation, engine emission Testing and Performance of IC Engine: Measurement of Indicated power, brake power, Friction Power, Willan's Line Method, (9) Morse Test, Motoring Test, Dynamometers, indicated thermal efficiency, brake thermal

efficiency and volumetric efficiencies, performance maps, Engine testing standards, heat

	balance sheet.
UnitV	Recent Trends in IC Engines: LHR engines, lean burn engines, stratified charge spark ignition engine, homogeneous charge compression ignition, reactivity-controlled compression ignition, six stroke engine concept, Electric Vehicle, hybrid engine vehicle, Hydrogen Internal Combustion Engine.
Text Bo	oks
T.1	Internal Combustion Engine by V Ganeshan, McGraw Hill Education Pvt. Ltd.
T.2	Internal Combustion Engine by R. K. Rajput, Laxmi Publication
Referen	ce Books
R.1	Internal Combustion Engines, E. Obert, Intex educational publication.
R.2	Internal Combustion Engine fundamental by John Heywood, Tata MCGraw Hill Publication

	UsefulLinks	
1	https://nptel.ac.in/courses/112104033	
2	https://nptel.ac.in/courses/112103262	

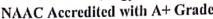
_	Course Outcomes	CL
BME33601.1	Interpret the principles of IC engines, including valve and port timing diagrams, to know advantages, disadvantages, and applications.	3
BME33601.2	Apply the concepts of engine cooling and lubrication systems to enhance the performance and reliability of internal combustion engines.	3
BME33601.3	Explain the function of ignition systems in SI and CI engines, including factors that influence knocking and abnormal combustion.	4 .
BME33601.4	Calculate SI and CI engine performance, including emission factors affecting knocking and detonation.	3
BME33601.5	Illustrate recent trends in IC engines to gain advantages, disadvantages, and challenges.	3

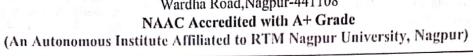
Pechanical Engineering (NBA Accredited) Tulsiramji Gaikwad Patil College of

Engineering, Nagpur



Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road,Nagpur-441108







	Th	ird Year (Sem	ester-VI) B. Tech. Mechanical Engineering	4 - 1 9		
1			3602: Mechatronics & Robotics			
	Teaching	Scheme	Exa	mination Sc		
Lect	ures	3Hr/Week	CI	•	30	
Tuto	rials	-	CA		10	
Total (Credits	3	ESI	ESE 60		
			Tota	100	Marks	
			Duratio	on of ESE: 03	Hrs	
Course	Objecti	ves:				
1			fundamental concepts of Mechatronics systems and its into			
2	To develop programming skills for automation using PLCs and design ladder logic diagrams for real-ti systems.					
3			Supervisory controlled Data acquisition system along with	virtual instrur	nentation	
			oring and control in modern industries.			
4	lo deve	lop foundational kn	owledge for robot hardware, design and integration	Mary To A	W-021	
5	To Unde	erstand different me	thods used for programming robots.	- AYUSB.		
			Course Contents	14.9	Hours	
Unit I	Case So	system, tudies on Mechat Antilock Braking S	d Circuits and Actuators, Control Systems, Close loop a ronics Systems such as Temperature Controller, High-ystem (ABS), Engine Management System, Smart Irrigationart HVAC (Heating, Ventilation, and Air Conditioning) Sy	Speed Tilting on System for	(9)	
Unit II	PLC pro Applica pneumat	gramming language	atroller (PLCs), Basic structure of PLC, Principle of operes, ladder diagram, latching, timer, counters, Selection criter ending and retracting a pneumatic piston using latches, celevator Control, Conveyor Belt with Object Sorting, Automatic Plants of the PLC, Principle of operes, latches, celevator Control, Conveyor Belt with Object Sorting, Automatic Plants of the PLC, Principle of operes, latches, celevator Control, Conveyor Belt with Object Sorting, Automatic Plants of the PLC, Principle of operes, latches, celevator (PLCs), Basic structure of PLC, Principle of operes, latches,	ria of PLC. control of two	(9)	
	monitori	ng.	(DAQ), Components of DAQ, Role of DAQ in real-time. VI): Its need, Tools use for Virtual Instrumentation, Society.			

Unit IV Unit I			
Unit V Robot Programming Methods: Manual Teach, Lead-through, Offline programming, PLC programming (intro to simulation tools like RoboDK or MATLAB Robotics Toolbox). Safety in Robotics: Safety sensors, emergency stops, safety standards (ISO 10218). Robotics Applications: Industrial: Welding, Painting, Pick and Place, Assembly, Inspection. Emerging: Agriculture, Medical Surgery, Defense, Warehouse Automation Text Books T.1 Mechatronics Borole,Rajesh P;Angal,Yogesh S;Patil,Varsha K., Nirali Prakashan, 4th Edition, 2005 T.2. Mechatronics Integrated Mechanical Ramachandran K.P., Willey. T.3 Boltan W, Mechatronics: Pearson Education, 11th Edition, 2005 Reference Books R.1 Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India	Unit IV	Types of Robots: Cartesian, Cylindrical, Articulated, SCARA, Delta, Mobile Robots. Basic Components of a Robot: Manipulator/Arm, End-effector (grippers, tools), Actuators (Electric, Pneumatic, Hydraulic), Sensors (Proximity, Vision, Force, IR, Ultrasonic), Controller	(9)
T.1 Mechatronics Borole,Rajesh P;Angal,Yogesh S;Patil,Varsha K., Nirali Prakashan, 4th Edition, 2005 T.2. Mechatronics Integrated Mechanical Ramachandran K.P., Willey. T.3 Boltan W, Mechatronics: Pearson Education, 11th Edition, 2005 Reference Books R.1 Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India	Unit V	Robot Programming Methods: Manual Teach, Lead-through, Offline programming, PLC programming (intro to simulation tools like RoboDK or MATLAB Robotics Toolbox). Safety in Robotics: Safety sensors, emergency stops, safety standards (ISO 10218). Robotics Applications: Industrial: Welding, Painting, Pick and Place, Assembly, Inspection. Emerging: Agriculture,	(9)
T.2. Mechatronics Integrated Mechanical Ramachandran K.P., Willey. T.3 Boltan W, Mechatronics: Pearson Education, 11th Edition, 2005 Reference Books R.1 Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India	Text Bo	oks	
T.3 Boltan W, Mechatronics: Pearson Education, 11th Edition, 2005 Reference Books R.1 Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India	T.1	Mechatronics Borole, Rajesh P; Angal, Yogesh S; Patil, Varsha K., Nirali Prakashan, 4th Edition, 2005	
Reference Books R.1 Introduction to Mechatronics and Measurement Systems , David Alciators & Michael B. Histand, Tata McGraw Hills, India	T.2.	Mechatronics Integrated Mechanical Ramachandran K.P., Willey.	1
R.1 Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India	T.3	Boltan W, Mechatronics: Pearson Education, 11th Edition, 2005	
McGraw Hills, India	Reference	ce Books	
R.2 Mechatronics: HMT LTD, McGraw-Hill	R.1		d, Tata
	R.2	Mechatronics : HMT LTD, McGraw-Hill	

	Useful Links
1	https://nptel.ac.in/courses/112103174
2	https://nptel.ac.in/courses/112107298

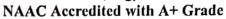
	Course Outcomes	CL
BME33602.1	Explain feedback control in Mechatronics systems to determine real-time case studies.	4
BME33602.2	Summarize ladder logic programs using timers for recent applications in Programmable Logic Controllers.	5
BME33602.3	Interpret data acquisition and SCADA systems for real-time industrial monitoring.	3
BME33602.4	Classify robots based on configuration to find requirements in specific applications.	4
BME33602.5	Differentiate robot programming methods to know safety protocols, design, and robot programming techniques.	4

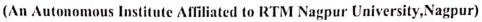
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Tie!	Thi	rd Year (Semes	ter-VI) B. Tech. Mechanical Engineering	- 1
			Principles of Industrial Management	
Tea	ching S		Examination	Schem
Lectu	res	2 Hr/Week	CT 15	Marks
Tutor	ials	-	CA 51	Marks
Total C	redits	2	ESE 30	Marks
	-,	- A Todaya P	Total 50	Marks
4		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Duration of ESE	: 02Hrs
Course	Objecti	ves:	e المراجع المر	
1	contex	ts.	cance of various management skills in different organizational	**
2			nt types of plant layouts.	
3			sion of material requirement planning (MRP) and storekeeping	g
	proced	lures by explaining	their underlying principles, processes, and objectives	
		of industrial Mana	Course Contents	Hours
UnitI	Cooper Plannin Function good I	ative Society-Adva ag Definition-Funct onal-Line &staff-ad eader Motivation	rganisation- Types- Proprietorship- Partnership- Joint stock- antages and disadvantages -Functions of Management – ions- Organisation- Definition- types of organisation –Line- vantages and disadvantages- Leadership -Types –Quality of - Maslow's Theory of Motivation -Hierarchy of needs- of Communication – Barriers for effective communication.	(9)
UnitII	Concer of site design definiti Produc (PPC)-	for project- Plant lay drawing-Specificat on-Job, Batch & I tivity-definition fact definition-Functions	Project planning -Market survey- Project capacity- selection yout-Types of Plant layout- Product design- Stages in productions-Material requirement-operation- Planning-Production Mass production with their advantages and disadvantages tors to improve productivity- Production planning and Controls of PPC- planning, routing, scheduling, dispatching and CPM and PERT -Comparision.	(9)
Unit III	Materia purchas tender- manage ledgers Invento concept	sing -Purchase proces Store keeping- comment Bin CardCodification of ry Control- Advantage , features and app	finition, functions- Purchase - Objectives, different methods of edure-Comparative statement-purchase order-Tender-Types of lassification of stores - Functions of store keeper. Store Material Issue Requisition-Material Returned Note- Store stores-Inventory Management- Definition - functions of stages of Inventory Control Enterprise resource planning oblications. Material Requirement Planning (MRP)-concept and benefits Supply shair management concept.	(9)

applications -Justin Time (JIT)-concept and benefits-Supply chain management-concept

and benefits -FIFO(first in first out) concept-definition.

Text Boo	oks	
T.1	IndustrialOrganizationandEngineeringEconomicsT.R.Banga&SCSharmaKhanna.Publishers	
T.2	IndustrialmanagementandengineeringeconomicsO.P.khannaKhanna.Publishers	
Referenc	e Books	Francisco
R.1	Industrial management and organizational behavior K.K.Ahuja	

	Useful Links	
1	www.youtube.com/watch?v=SF53ZZsP4ik	
2	www.youtube.com/watch?v=iPZlQ3Zx5zc	

	Course Outcomes	CL
BME33603.1	Explain the importance of management functions in industrial settings to gain knowledge of their impact on organizational performance.	4
BME33603.2	Apply knowledge of plant layouts to determine product design stages to real-world production scenarios.	· 3.
	Interpret materials management principles to optimize resource allocation and streamline production processes.	3

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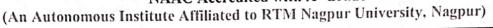
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College Of Engineering and Technology, Nagpur



Wardha Road, Nagpur-441108

NAAC Accredited with A+Grade





Third Year (Semester-VI) B. Tech. Mechanical Engineering

BME33604: Modelling And Simulation On Software

	Teac	hing Scheme	3		Examin	ation S	Scheme
Lecti		4 Hr/Week		promit it is	CT	11	-
Tuto	rials	-	The state of the s		CA		Marks
Tot	al	2		4000 0000 0000	ESE	25	Marks
	dits	_	are secretal liber and a				26.1
	Total					Marks	
		- 7 - 1		1.08(13.0	Duration of	ESE	: 02 Hrs
Cou	rse Ob	ectives:	to contract the second	3			
1	Underst	and the fundamenta	ls of 3D modeling and simulation	software (CRI	EO and ANSYS)	•	
2	Apply d	esign tools in CRE	O to create detailed part and asser	nbly models.	1.248		
3	Simulat	e and analyze real-v	vorld mechanical problems using	ANSYS.	-113		1 1 1 1
4	Integrat	e CAD and FEA too	ols for product development and t	esting.			1 1 1 1
5	Develor	skills for industry-	based design validation and optin	nization.		-	
Sr.		-	List of Experiment				CO
No.				shaniaal Comp	onent	44	201
1			tching and Part Modeling of a Mo		Joneni	Z 191	CO1
2	Advanc	ed 3D Modeling in	CREO: Gear, Coupling, or Crank	shaft			CO1
	1	The Later Control of the Control of	: Assemble a Shaft-Bearing-Hou		1000	2 10-4	CO2
3					370	L'ON I	150
4	Drafting	g and Detailing in C	REO: 2D Drawing Extraction fro	m 3D Model	the second of the second	Tope.	CO2
5	Introdu	ction to ANSYS: G	cometry Import and Meshing Tec	hniques	5.5	100	CO3
	Static S	tructural Analysis i	n ANSYS: Cantilever Beam unde	r Load			CO3
6							
7	Therma	l Analysis in ANSY	S: Heat Transfer through Fin				CO3
	Modal	Analysis in ANSYS	: Natural Frequency of a Bracket		l a l		CO4
0						1 1	
9	Stress Analysis of Assembly Model: Imported from CREO to ANSYS				CO4		
		oject: Design and A	nalysis of a Mechanical Part/Ass	sembly (e.g., C	hassis Frame or	la Jia	CO5

	t Books .	
T.1	"Creo Parametric 10.0 for Engineers and Designers" - Sham Tickoo	
T.2	"PTC Creo Parametric 10.0 Tutorial" - Kristin Eckstein, Roger Toogood	
T.3	"Learning Creo Parametric 10.0" – Randy Shih	1,

T.4 "Introduction to Finite Element Analysis Using ANSYS" – Saeed Moaveni	
Reference Books	
R.1 Practical Finite Element Analysis Author: Nitin S. Gokhale et al. Publisher: Finite to Infinite	3
R.2 ANSYS Workbench 2023 R1: A Tutorial Approach Author: Prof. Sham Tickoo Publisher: CADCIM Technologies	

Useful Links	
1 https://nptel.ac.in/courses/112104193	
2 https://nptel.ac.in/courses/112102101	· 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

	Course Outcomes	CL
BME33604.1	Demonstrate the ability to model complex mechanical components using CREO, to enhance knowledge of advanced features.	3
BME33604.2	Analyze the assembly modeling and drafting capabilities of CREO by creating complex assemblies for learning practical skills.	3
BME33604.3	Construct 3D models and assemblies using CREO to perform static analysis using ANSYS.	3
BME33604.4	Differentiate material behavior under various load conditions to find simulation results.	4
BME33604.5	Summarize engineering components through integrated use of CAD and FEA tools to determine optimization of Assembly model.	5

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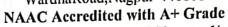
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(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)



Third Year (Semester-VI)B. Tech. Mechanical Engineering BME33605: (PE-II) Hydraulic And Pneumatic Systems

Lecti	'eaching	Scheme	· · · · · · · · · · · · · · · · · · ·		Ex	camination Sc	heme
	Lectures 4 Hr/Week		And the Part of the Control		C	T 30	Marks
Tutorials -				C	A 10	Marks	
			Aarks				
Total	ai Cicuits 7		Marks				
		4.41	1 11	Del Alegan		ion of ESE:03	
Course	Objectiv	VAG.	<u> </u>		Duran	1011 01 202102	
l l			e Fundamentals of flu	uid nower	a age (Second		
2			esign Systems of hyd				
3			al Skills Pneumatic sy			1 8 1	<i>y</i> .
	Students	will apply I faction	Course Co				Hour
			Course Co	ittents			-
d a section	Fluid Po	ower Priniciples A	and Hydraulic Pump	os			1
		, i	•			T	1
UnitI	Introduc	tion to Fluid powe	r – Advantages and A	applications - Fluid po	wer systems –	Types of	1 - 1
	fluids— I	Properties of fluids	and selection – Basic	es of Hydraulies – Pasc	cal's Law – Pri	nciples of flow	(9)
	- Frictio	n loss – Work, Po	wer and Torque Probl	ems, Sources of Hydra	aulic power : P	umping Theory	
	- Pump	Classification – Co	onstruction, Working,	Design, Advantages,	Disadvantages,	, Performance,	
	Selection	n criteria of Linear	and Rotary – Fixed a	and Variable displacem	nent pumps – P	roblems.	
	Hydrau	lic Actuators And	Control Componen				
	11,411			ıts		2.	
			1			Carrier.	
	Hydraul	ic Actuators: Cylin	ders – Types and con	struction, Application	, Hydraulic cus	shioning —	3
	Undrowl	ic Actuators: Cylin ic motors – Contro	ders – Types and con	struction, Application	, Hydraulic cus	shioning –	(0)
UnitII	Hydraul	ic motors - Contro	ders – Types and con l Components: Direct	nstruction, Application tion Control, Flow con	itrol and pressu	ire control	(9)
UnitII	Hydraul valves –	ic motors – Contro Types, Construction	ders – Types and cor l Components: Direction and Operation – S	nstruction, Application tion Control, Flow con ervo and Proportional	itrol and pressu valves – Appli	re control cations –	(9)
UnitII	Hydraul valves – Accesso	ic motors – Contro Types, Construction ries: Reservoirs, Pr	ders – Types and corl 1 Components: Direct on and Operation – S ressure Switches – Ap	nstruction, Application tion Control, Flow con	itrol and pressu valves – Appli	re control cations –	(9)
UnitII	Hydraul valves – Accesso	ic motors – Contro Types, Construction	ders – Types and corl 1 Components: Direct on and Operation – S ressure Switches – Ap	nstruction, Application tion Control, Flow con ervo and Proportional	itrol and pressu valves – Appli	re control cations –	(9)
	Hydraul valves – Accesso Problem	Types, Constructions: Reservoirs, Programmes: Reservoirs, Programmes and State and Sta	ders – Types and con 1 Components: Direct on and Operation – S ressure Switches – Ap	nstruction, Application tion Control, Flow con ervo and Proportional pplications – Fluid Pov	atrol and pressu valves – Appli wer ANSI Sym	are control cations — abols —	a to see
	Hydraul valves – Accesso Problem Hydrau Accumu	Types, Construction of the	ders – Types and con l Components: Direction and Operation – Stressure Switches – Aparts – Systems ystems	nstruction, Application tion Control, Flow con ervo and Proportional pplications – Fluid Pov c circuits – Regenerat	atrol and pressu valves – Appli wer ANSI Sym ive, Pump Un	cations – abols – loading, Doubl	e- (9)
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	in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.
Text Bo	oks
T.1	Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
T.2	Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
T.3	Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.
Reference	ee Books
R.1	Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976.
R.2	Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
R.3	Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

	Useful Links	
1	https://archive.nptel.ac.in/courses/112/106/112106300/	
2	https://archive.nptel.ac.in/courses/112/105/112105047/	

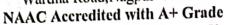
	Course Outcomes	CL
BME33605.1	Summarize the fundamentals of fluid power to determine hydraulic system design requirements.	4
BME33605.2	Select appropriate hydraulic control components, to achieve desired system performance	4
BME33605.3	Analyze hydraulic system designs, to determine performance, stability, and control.	4
BME33605.4	Apply pneumatic and electro-pneumatic principles to find out troubleshoot circuits using air control valves,	
BME33605.5	Explain troubleshooting techniques and remedies for common issues in hydraulic and pneumatic systems,	4

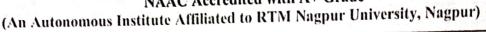
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Wardha Road, Nagpur-441108







Third Year (Semester-VI) B. Tech. Mechanical Engineering BME33606: (PE-II) Mechanical Measurement and Metrology **Examination Scheme Teaching Scheme** 30 Marks CT 4 Hr/Week Lectures 10 Marks CA Tutorials 60 Marks ESE **Total Credits** 4 100 Marks Total Duration of ESE:03Hrs **Course Objectives:** Understand the basic structure and principles of measuring system Explore various sensing and signal conditioning elements used in measurement systems Familiarize students with the instruments used for measuring pressure, displacement, force, torque and power To understand standards of measurement, linear and angular measurement methods, and precision 4 Provide knowledge on limits and fits, gauges and advanced inspection tools for precision 5 engineering Hours **Course Contents** Purpose, structure and elements of measuring system. Static characteristics of measurement system, elements including systematic, statistical characteristics, generalized model of system elements and calibration. Error measurement, error probability density function, error (9) UnitI reduction. Introduction to dynamic characteristics of measurement system. Introduction to noise in measurement system. Classification, Principle, Sensing elements, Signal conditioning elements, Construction, Range and working of instruments for measurement of Linear and Angular Displacement, , (9) UnitII Speed, Load, Strain, Force, Torque and Power. (Analytical treatment not included) Classification, Principle, Sensing elements, Signal conditioning elements, Construction, Unit III Range and working of instruments for measurement of Pressure, Vacuum, Sound, Light and (9) Temperature. (Analytical treatment not included) Standards of Measurement, Line, End and Wavelength standard, Working standards, Requirement of interchangeability, Allowance and Tolerance, Selective assembly, Measurement of Straightness and Flatness. Instruments for Linear and Angular (9) UnitIV Measurement. (Vernier, Angle gauge, Sine bar, Level indicator, Clinometers and Taper gauge) Limits and Fits, Tolerance analysis of Limits and Fits, Types of limit gauges, Types of fit, Shaft and Hole basis system, Design of Limit gauge and Process planning sheet (Numerical (9) UnitV treatment is expected). Comparators: Mechanical, Optical, Electrical, Electronic, Pneumatic. Study and use of

Optical profile projectors, Tool maker's microscope and Autocollimator. Measurement of

	Screw thread and Gear tooth.
Text Bo	oks
T.1	Mechanical Measurement and Control, D.S. Kumar, Metropolitan Book Co
T.2	Metrology, R. K. Jain, Khanna Publishers
T.3	Instrumentation Measurement and Analysis, B.C. Nakra, K.K. Choudhary, TMH
Referen	e Books
R.1	Principles of Measurement Systems, John P. Bentley, Pearson
R.2	Metrology and Measurement, Anand K. Bewoor, Vinay A. Kulkarni, TMH

	Useful Links		Time.	
1	https://nptel.ac.in/courses/112104250	and the same and the particles of the same		
2	https://nptel.ac.in/courses/112106139	the state of the second with the second	March 110 Per	

	Course Outcomes	CL
BME33606.1	Explain the fundamental principles of measurement systems, to ensure accurate and reliable measurements.	4
BME33606.2	Interpret the principles of measurement instruments for linear and angular displacement.	3
BME33606.3	Summarize the operation of measurement instruments for pressure, temperature,	5
BME33606.4	Apply measurement standards and techniques, to ensure interchangeability and specify tolerances for precise engineering applications.	4
BME33606.5	Evaluate the use of advanced measurement instruments, to inspect complex parts.	5

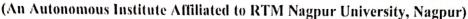
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Engineering, Nagpur



Wardha Road, Nagpur-441108

NAAC Accredited with A+ Grade





Third Year (Semester-VI) B. Tech. Mechanical Engineering BME33607: (PE-II) Automotive Maintenance and Industrial Safety **Teaching Scheme Examination Scheme** Lectures 4 Hr/Week CT 30 Marks **Tutorials** CA 10 Marks **Total Credits** 4 ESE 60 Marks Total 100 Marks Duration of ESE:03Hrs Course Objectives: Equip students with knowledge on accident causes, prevention methods, industrial hazards, and safety Provide a comprehensive understanding of maintenance engineering principles, types, and equipment life-2 cycle management. Study wear and corrosion prevention, and lubrication methods for enhancing system reliability. 3 Develop skills to systematically trace, analyze, and diagnose faults in various equipment using structured Equip students with skills for periodic and preventive maintenance of mechanical and electrical equipment. 5 **Course Contents** Hours Industrial Safety Accident, causes, types, results and control, mechanical and electrical hazards, types, causes UnitI (9) and preventive steps/ procedure, describe salient points of factories act1948 for health and drinking water layouts, light, cleanliness, fire, guarding, pressure safety, washrooms, vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods. Maintenance Engineering (9) Definition and aim of maintenance engineering, Primary and secondary functions and UnitII responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. Wear and corrosion and their prevention Wear-types, causes, effects, wear reduction methods, lubricants-types and applications, (9) Unit III Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. Fault Tracing UnitIV Fault tracing-concept and importance, decision tree concept, need and applications, sequence (9) of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Anyone

machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi.

- 1177	Electrical motors, Types of faults in machine tools and their general causes.	
	Periodic and preventive maintenance	
	Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles	
UnitV	and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Airc ompressors, iv. Dieselgenerating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical	
Text B	equipment, Advantages of preventive maintenance. Repair cycle concept and importance.	
T.1	L M Deshmukh, Industrial Safety Management, Tata Mc Graw-Hill Education, 2005.	1, 19
1.1	E in Desimilari, industrial Safety Management, I ata Mc Graw-Hill Education, 2005.	
T.2	Charles D.Reese,Occupational Health and Safety Management: A Practical Approach, CR C Press	
Referen	ce Books	in part
R.1	Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solution John Wiley & Sons, 2007.	ns,
R.2	H. P. Garg, Maintenance Engineering, S. Chand Publishing.	

-1	Useful Links	1714 TUIL	-v3-:
1	https://nptel.ac.in/courses/112103264		
2	https://www.osha.gov/industrial-safety	19-08-07-0	

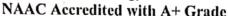
	Course Outcomes	CL
BME33607.1	Explain the causes, types, and consequences of industrial accidents, and describe measures to control mechanical and electrical hazards,	4
BME33607.2	Interpret the role and responsibilities of maintenance engineering, to optimize equipment performance and minimize downtime.	3
BME33607.3	Analyze the types, causes, and effects of wear and corrosion on equipment, and to determine methods for prevention and mitigation.	4
BME33607.4	Illustrate the application of decision trees to troubleshoot common problems in machine tools.	3
BME33607.5	Summarize the steps and advantages of preventive maintenance for pumps, air compressors, to minimize downtime	5

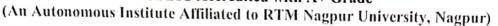
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Third Year (Semester-VI) B.Tech. Mechanical Engineering BME33608: (PE-II) Control System Engineering **Teaching Scheme Examination Scheme** Lectures 4Hr/Week CT 30 Marks **Tutorials** CA 10 Marks **Total Credits** 4 **ESE** 60 Marks Total 100 Marks DurationofESE:03Hrs Course Objectives: To study modeling and transfer function of linear time-invariant system 2 To understand the stability, time domain specifications and tools To understand classical controller/compensator design for linear system 3 To study frequency domain analysis of linear system 4 An introduction to state space approach and to understand the theory state transition matrix Course Contents Hours Introduction to Control System: Need of control system, Open loop control and closed loop control, Significance of actuators and sensors, Control system Components (DC/AC servomotors, potentiometer, synchro), Mathematical representation of simple mechanical, UnitI (9) electrical and electromechanical systems, Transfer function, Block diagram representation and reduction. Signal flow graph. Time Response Analysis: - Concept of transient response, steady state response and time response, standard test signals-type and order of system, steady state error analysis, static UnitII error constants, Time response of first and second order system, dominant poles, Time (9) response specifications of second order system, Different types of Controllers (PD, PI, PID) Introduction of LAG, LEAD compensation. Stability analysis & Root locus: Stability of control systems, condition of stability, Unit III characteristics equation, Routh Hurwitz criterion, special cases for determining relative stability. Root location and its effect on time response, elementary idea of root locus, effect (9)of addition of pole and zero on proximity of imaginary axis. Frequency Domain Analysis: - Concept of frequency response of a dynamical system. Construction of Bode plot, the stability margin on Bode plot and assessing close-loop stability. Construction of polar plot for a system. Nyquist stability criterion and stability UnitIV (9) margin. Effect of gain variation and addition of poles and zeroes on the frequency response State Variable Analysis: - Concept of state, state variable and state model, Systems state model with physical variable, phase variable and canonical variables with state diagram, UnitV (9) Transfer function from state model, Stability of state space model. Text Books Modern control system Engineering by K.Ogata, Publisher - Prentice Hall, India T.1 Control System Analysis by Nagrath /Gopal, Publisher- Newage International T.2 Automatic Control Systems by B.C. Kuo, Publisher - Prentice Hall, India T.3

T.4	Control System Engineering by S.K. Bhattacharya, Publisher - Pearson
Reference	ee Books
R.1	Linear System Design by D'azzoand Houpis, Publisher- McGraw Hill
R.2	Control Systems, Principles & Design by M. Gopal Publisher – TMH (Tata Mc Graw Hill)
R.3	Control Systems Engineering by Samarajit Ghosh Publisher - Pearson

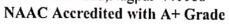
	Useful Links	
1	https://www.youtube.com/watch?v=7LZSjgZz	
	Qw&list=PLxn52v8fxX5l5tGzU1NAxRDkgqxK0k5UZ	
2	https://www.youtube.com/watch?v=39Ggoj2fQ2c&list=PLxn52v8fxX5l5tGzU1NAxRDkgqxK0k5U	1
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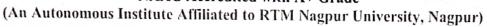
	Course Outcomes	CL
BME33608.1	Apply block diagram reduction and signal flow graph techniques to simplify complex control systems	3
BME33608.2	Explain the time response characteristics of first and second-order systems, to determine system performance	4
BME33608.3	Analyze the stability of control systems using Routh-Hurwitz criterion to determine relative stability,	4
BME33608.4	Summarize the key concepts of frequency response analysis, and the use of Nyquist criterion to evaluate system stability	4
BME33608.5	Apply the state variable approach to model to determine the behavior of dynamic systems.	3

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Third Year (Semester-VI)B. Tech. Mechanical Engineering

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		BME3360	9: (PE-III) Finite Elemen	nt Method	0		
	Teaching Scheme Examination Sc						cheme
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					Duration of E		
Course	Objecti	ves:			Duration of E	31.03	71115
1		and the Fundame	tal Principles				
2	Apply I	FEM to Solve Eng	neering Problems				
3	Develop	Computational S	kills				
4	Analyz	e and Interpret FE	M Results				
5	Enhanc	e Problem-Solvin	and Research Skills				
			Course Contents				Hours
	Introdu	ction to Enginee	ing Analysis tool FEA and	its application	n in Linear st	tatic	riours
UnitI	Anaiysi	is and				1	(9)
	2D pro	blems, Study of F	nite Element modeling and sim	nulation Techn	iques, Use of F	FEA	()
	ın struc	tural vibration and	thermal Analysis.				
	Basics	of FEM – Review	of finite difference method, In	nitial value an	d boundary val	uç	
UnitII	Poloich	ns Solution of Bo	undary Value problems: - we	eighted residua	al, Galerk in a	nd	(9)
	machla	KIIZ methods,	Variational Method, Least squ	uare Methods	. Introduction	to	
	Two D	imensional Fleme	Linking mechanical design with nts: Linear Triangular Elemen	1 FEA			1
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Unit III	integrat	ion. Integral equa	ions for the element Matrices, I	Heat transfer b	ents and numer	One	(9)
	dimensi	onal fins, two d	mensional fins, and Long and	d convection	Two Dimension	one	
	bodies.	,	,		Two Dimension	Jilai	
	FEA a	oplications in So	lid Mechanics:The axial for	ce members.	potential ene	rgv	
UnitIV	formula	tions. The Truss I	lement, Beam element, plane f	frame element	, modeling of b	olts	(9)
	for asser	mbly,3Dproblems			· ·		()
	Two di	mensional Elastic	ity: The displacement function	ons, Element	matrices, Elen	nent	
	Shape F	unctions: Evaluati	ng shape functions FEM Comp	utations Solut	ion Methods,		(9)
			essingFEMHardwareandPostpr	rocessingSurve	eyofsomeFE		` ′
		e Systems.					
Text Boo							
T.1			. An introduction to the finite ele	ment method.V	/ol.2,no.2.2. Nev	v York	c: Mc
T 0	Graw-Hi						
T.2			., Ashok D. Belegundu, T. Ra			oduct	ion to
T 2	Tinite ele	ements in enginee	ing. Vol. 2. Upper Saddle Rive	er, NJ: Prentic	e Hall, 2002.		
T.3	Desai, C	handrakant S.,and	John Fredrick Abel Introducti	ion to the finit	e element meth	iod; a	
	numeric	at method for eng	neering analysis. Van Nostran	d Reinhold, 1	971.		

T.4	Zienkiewicz, OlekC., and Robert L. Taylor. The finite element method: Its basis and fundamentals.
Reference	e Books
R.1	K.J. Bathe, Finite Element Procedures, Klaus-Jurgen Bathe 6. Singiresu s. Rao. Finite element method in engineering.
R.2	Cook, R.D, "Concepts and application in Finite Element Analysis", 3rd Ed, The Wiley & Sons
R.3	Dixit U.S., "Finite Element Methods for Engineers", Cengage Learning

	Useful Links
1	https://www.youtube.com/watch?v=tH1ygapKG2g&list=PLSGws_74K018SmggufD-pbzG3thPIpF94&index=2
2	https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94

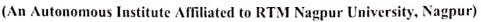
	Course Outcomes	CL
BME33609.1	Apply FEA modeling and simulation techniques to solve complex engineering problems	3
BME33609.2	Apply Different FEM Methods for the Solution of Boundary Value problems.	4
BME33609.3	Summarize the numerical methods for solving boundary value problems,	5
BME33609.4	Apply FEM Methods for the solution of 3D object	4
BME33609.5	Evaluate the effectiveness of FEM modeling and preprocessing techniques for two- dimensional elasticity problems	5

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Tulsiramji Gaikwad Patil College of

Engineering, Nagpur



Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441108 NAAC Accredited with A+ Grade





	,	An Autonomous	ustitute Amiliated	to KTM Nagpur Unive	rsity, (vagpur)	
		Third Year (S	emester-VI) B. 7	Tech. Mechanical E	ngineering	
		BME33610: (E-III) Advance	d Manufacturing To	echniques	
	Teachin _i	g Scheme			Examination Sc	heme
Lect	ures	4 Hr/Week			CT 30	Marks
Tuto	rials	-			CA 10	Marks
Total (Credits	4			ESE 60	Marks
					Total 100	Marks
	Þ				Duration of ESE:03	Hrs
Course	Objecti					
1	To unde	erstand the evolution	and trends of advance	d manufacturing and its co	mparison to traditional	methods.
2	To expl	lore additive manufa	turing processes, their	benefits, and limitations.	Establish Committee	
3	To lear	n about subtractive o	nd hybrid manufacturi	na taskaisusa		
3	10 lear	ii about subtractive a	id nybrid manufacturi	ng techniques.	F 1. 100 PT 2	
4	To stud	ly advanced material	and processing techn	iques.		
5	To exp	lore the applications,	quality control, and fu	ture trends in manufacturin	ng.	
1			Course Cont	ents		Hours
UnitI	Advano Techno Manufa	ced Manufacturing llogical Advanceme acturing; Advantages	Techniques; Compar ts Driving Manufact of Advanced Manufac	Overview of Manufacturing ison with Traditional Mauring Innovation; Emerging Techniques; Future	anufacturing Processes ng Trends in Advance Scope and Challenges	5; (9)
UnitII	Evoluti Additiv Manufa	on and Technologion Manufacturing; Cturing; Additive vs	al Improvements; Al Advantages of Ado Conventional Manufa	ntroduction to Additive M Process and Classifica ditive Manufacturing; Li acturing Processes	tion; Materials Used i imitations of Additiv	n (9)
Unit III	(Machini (ECM);	ing and Automation Laser Beam Mach	; Electric Discharge	troduction to Subtractive Machining (EDM); Elec- ing; Hybrid Manufacturing ses	ctrochemical Machinin	0 (0)
UnitIV	Material High-Pe Welding	Forming Technique rformance Materials and Joining Methoo	s, Powder Metallurgy in Manufacturing, C s, Future Trends in M		Manufacturing Material aterials, Non-Tradition	s. (9)
Applications, Quality, and Future Trends; Applications in Aerospace, Automotive, Biomedical, and Electronics, Digital Manufacturing and Industry 4.0, Smart Factories and the Role of IoT, Cyber-Physical Systems and Automation, Quality Control and Inspection Techniques, Process Control and Optimization, Sustainability and Green Manufacturing, Future Trends in Manufacturing Technologies						
Text Bo						
T.1	"Introd	uction to Manufac	uring Processes" by	Mikell P. Groover		
T.2	"Additi	ve Manufacturing:	Materials, Processes	s, Quantifications, and A	pplications" by Kun Z	hou

T.3	"Modern Machining Technology" by Chandra Sekhar
Referen	ce Books
R.1	Understanding Additive Manufacturing Rapid Prototyping · Rapid Tooling · Rapid Manufacturing Andreas Gebhardt, Hanser Publishers, Munich Hanser Publications, Cincinnati
R.2	Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Li Yang Keng Hsu Brian Baughman Donald Godfrey • Francisco Medina Mamballykalathil Menon SoerenWiener, Springer Series in Advanced Manufacturing

	Useful Links
1	https://onlinecourses.nptel.ac.in/noc21_mel15/preview
2	https://onlinecourses.nptel.ac.in/noc20_me50/preview

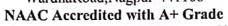
	Course Outcomes	CL	
BME33610.1	nterpret the differences between traditional and advanced manufacturing processes, to ind the benefits of adopting advanced manufacturing techniques.		
BME33610.2	Summarize the key concepts of Additive Manufacturing (AM) and 3D Printing, to find advantages, limitations, and comparison with conventional manufacturing processes.		
BME33610.3	Analyze subtractive manufacturing processes, to determine their applications and advantages.	4	
BME33610.4	Interpret the properties of advanced materials, for requirement in various manufacturing industries.	3	
BME33610.5	Explain the concepts of smart factories, in modern manufacturing, for process optimization.	4	

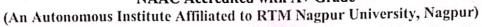
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	`		Harris Maria		15 - 15 10a 1 - 111 - 11	
		Third Year (S	emester-VI) B.Tech. Mechanic	cal Eng	gineering	, t
		BME	33611: (PE-III) Operation Re	search		
	Feaching	Scheme	8		Examination	
Lect	ures	4 Hr/Week		L	0.2	30 Marks
Tuto	rials				01-	10 Marks
Total (Credits	4			ESE	60 Marks
				Γ	. 0	00 Marks
		* 1	N	: T	DurationofESE:)3Hrs
Course	Objecti	ves:				
1		dy the various OR	ools,		7	
2	To app	ly appropriate mod	el to the given situation.			
3		mulate the problem				
4		ve and analyze the				
5	To ma	thematical models	and solve management problems.			
		- V	Course Contents		,	Hours
			asic O.R. Models, Characteristics, phase	es & Me	thodology of O.R	
Unit I	Limitations & Applications. Linear Programming:-Introduction, Linear programming problem formulation, LPP Solution by					(9)
			ex Method, Principle of Duality & For			
	Sensiti	vity Analysis Conce	pt Only.			. 55 760
	Formu	lation of transpor	ation model, Basic feasible solution	using d	ifferent methods	1
	(North	- West corner, Les	st Cost, Vogel's Approximation Meth-	od) Opti	imality Methods,	(9)
Unit II			problem, Variants in Transportation Pr			
		nent & travelling s	signment problem, unbalanced assig	gnment	problem, typical	
			ncept of equivalence, Interest Rate,	Present	worth econom	ic
Unit III			s, Group replacement models.		worting occinent	(9)
Chit III			- Introduction and inventory manager	ment cor	cepts, Economic	
	Order	Quantity model (E	OQ), Economic Production Quantity	model (EPQ), model for	
			tages, ABC analysis.			
	Drawin	g of Network, CPI	1 & PERT, probability of completion of	of projec	ct, Cost Analysis	
Unit IV			ashing. Allocation & updating of Netw		11	(9)
			luction, Sequencing Model n job two	machine	es problem, n job	
	machine	es problem, 2 jobs	n machine problem.	invanta	and materials	(9)
Unit V	Simulat	ions –Concept, ap	plications in waiting line situations, arrivals and Exponential service times	, invento	e channel models	
	Queuing	g models— Poisson	models. (No derivation expected)	s –singi	e chainer models	'
Text Boo		and Multi Chaimer	models. (140 derivation expected)			
T.1		on Research Heer	& Gupta, S Chand Publications			
T.2			harma, Mc Millian Publications			
T.3		on Research, SDS	harma, Kedarnath Ramnath &Co.			
eference		n Daganet II.	. Taka Brantica Hall			
R.1	Operation	on Research, Hamo	y Taha, Prentice Hall			

Operation Research, Liberman, Mc GrawHillPublications **R.2**

	Useful Links		- Street
1	https://nptel.ac.in/courses/110/106/110106062/	4	
2	https://examupdates.in/operation-research-notes/		2. 1

y 1 1 10 10 10 10 10 10 10 10 10 10 10 10	Course Outcomes	CL
BME33611.1	Solve linear programming problems using graphical to formulate dual models.	3
BME33611.2	Determine the optimal solution to transportation problems using North-West corner method,	4
BME33611.3	Apply an optimal replacement period of equipment or machine to determine the value of the given Inventory Model.	3
BME33611.4	Illustrate project networks using CPM and PERT techniques, to determine project completion probability.	3
BME33611.5	Summarize the key concepts of queuing theory, to solve real-world problems.	5

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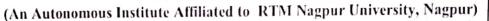
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	7	Third Year (Se	nester-VI) B. Te	ch. Mechanical H	Engineering			
1 2 2 19:		BME33	612: (PE-III) In	dustrial Robotics				
T	eaching	Scheme	9	Powlarder was a self-relative	Examination Sc	heme		
Lectu		4 Hr/Week			CT 3	0 Marks		
Tutor		-			CA 1	0 Marks		
Total C	redits	4			ESE 6	0 Marks		
					Total 10	00 Marks		
					Duration of ESI	E:03Hrs		
Course	Objecti	ves:						
			elements of robotics.					
			ot end effector and gr	ippers.				
			nd control of manipul					
			cepts of robotic sensor					
			ts of robots and their i					
			Course		-	Hours		
		Contents						
	Basic concepts :-Brief history-Types of Robot-Technology-Robot classifications and				classifications and			
	specifications- Design and control issues-Various manipulators-Sensors- workcell-					(9)		
		nming languages.	10 1 00		Lastina as liΩina			
	Robot s	send- effectors- clas	ification o fend- effection vac	tors, mechanical gripp uum cups ,magnetic gri	ers, nooking or inting			
UnitII	grippers	s, grippers for mone	i metai s, piastics, vac	rippers, drives ystems	for gripers, active &	(9)		
		grippers.	midilar oc externar g	ppv.o, a.r. to jarana	,			
	Direct a	and inverse kinemati		sentation of Robots-Po				
Unit III	-Homog	geneous transformat	on Various joints-Rep	resentation using the De	enavit Hattenberg	(9)		
				atics-Inverse kinemati	cs- SCARA robots-			
			ods-Closed form solution	on. et type sensors, force, to	orgue touch position			
UnitIV				o-optical imaging sense				
Ciliti				d robot input/ output				
	intelligence, and materials					Hamme		
	Safety r	measures in robots,				es. 25 27		
				interface, other consid				
	design, work cell control, interlocks, error detection and recovery, Quantitative Techniques for economic performance of robots: Robot investment coats, robot operating expenses. General					(9)		
UnitV				erial transfer applicati				
	operatio	ons, machine loadin	and unloading, die	easting, plastic molding	g, forging, machining			
ž	operation	ons, stamping press	perations using robots		5, 1018.115, 1114.11111116			
Text Bo								
T.1	K. Mitt	talandI. J.Nagrath, R	obotics and Control,T	ata Mc Graw Hill, New	Delhi,4thReprint, 20	05		
T.2				drej, Industrial Robotic				
T.3		Craig, Introduction to	Robotics Mechanics	and Control, Third edi	tion, Pears on Educati	on		

Referenc	e Books
R.1	Ashitava Ghoshal, Robotics- Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
R.2	K. K. Appu Kuttan, Robotics, I K International, 2007. Edwin Wise, Applied Robotics, Cengage Learning.
R.3	R. D. Klafter, T.A. Chimielewski and M. Negin, Robotic Engineering – An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
R.4	B.K. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
R.5	S. Ghoshal, "Embedded Systems & Robotics"-Projects using the 8051 Microcontroller", Cengage Learning, 2009.

K1 7	Useful Links
1	https://onlinecourses.nptel.ac.in/noc23 me143/
2	https://archive.nptel.ac.in/courses/112/105/112105249/
3	https://www.youtube.com/watch?v=OSrMXiaWPZY&list=PLXDsvE7qtfNf_N99hJZbdTEM001m Oii6_&index=1

	Course Outcomes	CL
BME33611.1	Analyze the design and control issues of robots, to determine their impact on robot performance.	4
BME33611.2	Interpret the role of drive systems and control mechanisms in robot end-effectors, to find impact on robotic performance.	4
BME33611.3	Summarize the methods for solving direct and inverse kinematics problems in robotics,	4
BME33611.4	Discuss the types of robot sensors for its applications.	3
BME33611.5	Illustrate the application of robots in material handling, including quantitative techniques for determining economic performance	3

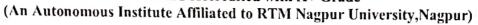
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- 121			ar (Semester-VI) B. Tech. Mechanical Engineering		
1.2			BCS33601: Artificial Intelligence	1 1 10 1 11	
Teaching Scheme E				Examination Scheme	
Lectures Tutorials		2 Hr/Week	CT , 1	5 Marks	
		2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	CA J. O	5 Marks	
Total C			ESE / 3	0 Marks	
		THE MENTALL	Total 5	0. Marks	
C	1619-1	a efficient	Duration of ESE:	02Hrs	
Course (7,11115	the Attention of the		di ghi o	
1	Underst	and the fundame	Fre and termine to glob of the und tridentine Dearthing.	man j	
2	Develop	skills to choose	e, plan, and execute Al projects collaboratively within a team.	Si F	
3	Recogn	ize the roles and	responsibilities of Al team members within organizations.		
			Course Contents	Hours	
UnitI	What m	achine kuming ca	arning, What is data, The terminology of AI, What makes an AI compan and cannot do. Non-technical explanation of deep learning basic	any, s of (9)	
Unitl	What meural n Building How to	achine kuming ca etworks. Examples g Al projects Work use data, How to	an and cannot do. Non-technical explanation of deep learning, basic s of Al. Application domains of Al kflow of a machine learning project, Workflow of a data science pro choose an Al project, Working with an Al team, How to process	s of (9)	
Unitl	What meural n Building How to visualize	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to	an and cannot do. Non-technical explanation of deep learning, basic is of Al. Application domains of Al kflow of a machine learning project, Workflow of a data science proof choose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects	ject, and	
UnitI	What meural n Building How to visualize Building team, A Al and S	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Complete protalls to avoid, Society A realistic	an and cannot do. Non-technical explanation of deep learning, basic s of Al. Application domains of Al kflow of a machine learning project, Workflow of a data science pro choose an Al project, Working with an Al team, How to process	ject, and (9)	
UnitI	Building How to visualize Building team, A Al and S of AL, A	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Complete I protalls to avoid, Society A realistic Al and developing	an and cannot do. Non-technical explanation of deep learning, basic is of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science protochoose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Apany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas Eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse economies, Al and jobs	ject, and (9) n Al uses (9)	
UnitII UnitII	Building How to visualize Building team, A Al and S of AL, A	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Complete I protalls to avoid, Society A realistic Al and developing	an and cannot do. Non-technical explanation of deep learning, basic is of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science proto choose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Apany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas Eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse	ject, and (9) n Al uses (9)	
UnitII UnitIII Text Bo	Building How to visualize Building team, A Al and S of AL, A	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Com l protalls to avoid, Society A realistic Al and developing	an and cannot do. Non-technical explanation of deep learning, basic is of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science protochoose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Apany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas Eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse economies, Al and jobs	ject, and (9) n Al uses (9)	
UnitII Unit III Text Book	Building How to visualize Building team, A Al and S of AL, A oks Artific Artific	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Com l protalls to avoid, Society A realistic Al and developing ial Intelligence: A	an and cannot do. Non-technical explanation of deep learning, basics of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science protochoose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Expany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse economies, Al and jobs A Modern Approach Stuart Russell Peter Norvig 2010 Prentice Fine Basies Kevin Warwick, Routledge 2nd edition Routledge	ject, and (9) n Al uses (9)	
UnitII Unit III Text Bo T.1 T.2	Building How to visualize Building team, A Al and S of AL, A oks Artific Artific	achine kuming ca etworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Com l protalls to avoid, Society A realistic Al and developing ial Intelligence: A	an and cannot do. Non-technical explanation of deep learning, basic is of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science protoco choose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Apany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas Eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse economies, Al and jobs A Modern Approach Stuart Russell Peter Norvig 2010 Prentice F	ject, and (9) n Al uses (9)	
UnitII Unit III Text Boo T.1 T.2 Referenc	Building How to visualize Building team, A Al and S of AL, A oks Artific Artific	achine kuming caetworks. Examples g Al projects Work use data, How to e nata. Tectitical to g Al in Your Com l protalls to avoid, Society A realistic Al and developing ial Intelligence: A ial intelligence To ial intelligence for	an and cannot do. Non-technical explanation of deep learning, basics of Al. Application domains of Al Ekflow of a machine learning project, Workflow of a data science protochoose an Al project, Working with an Al team, How to process wats for Al teams, use of python in Al related projects Expany: Smart speaker, Case study: Self-driving car. Example roles of a Survey of major Al application areas eview of Al, Discrimination/Bias, Adversarial attacks on Al, Adverse economies, Al and jobs A Modern Approach Stuart Russell Peter Norvig 2010 Prentice Fine Basies Kevin Warwick, Routledge 2nd edition Routledge	ject, and (9) n Al uses (9)	

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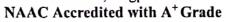
	Course Outcomes	CL
BCS33601.1	Explain the fundamentals of machine learning, including data, AI terminology, and the capabilities to enhance knowledge of machine learning.	4
BCS33601.2	Interpret the technical tools and methodologies used in AI projects, to determine their effectiveness in project development.	2
BCS33601.3	Evaluate the applications and implications of AI in industries, to find potential risks and benefits.	5

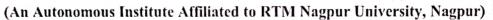
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Third Year (Semester-VI) B. Tech. Mechanical Engineering

BME33613: Internal Combustion Engine Lab

Te	eaching Scheme		Examination Scheme	
Lectures	2Hr/Week		CT	-
Tutorials	- · ·	The state of the second	CA 2	5 Marks
Fotal Credits	1		ESE 2	5 Marks
		2, 41	Total 5	0 Marks
11 11			Duration of ESI	E: 02 Hrs
Course (Objectives:	The Committee of the Section of the		1000
1 To le	arn the basic concep	ot of I C Engine	Park of Park (CR)	
2 To e	nhance the knowled	ge of IC engine	en en en	A- A, I
		ledge of type of fuels used in IC engines and the	fuel supply syste	ems
4 To d	escribe combustion	phenomena in IC engines	ruer suppry syste	
5 To e	xplain the different	performance analysis of IC engines		-
Sr.		List of Experiment	5W7	CO
	animsbeda nee		1.	
		ılti cylinder Petrol Engine.		< CO1
		ılti cylinder Diesel Engine.		CO1
3 Dem	onstrate The Signifi	cance Of Fuel Injection And Ignition Systems O	f IC Engine	CO2
4 Dem	onstrate The Import	ance of Different types of Carburetor used in Pe	trol Engine	CO2
		ance Of Engine Cooling And Lubrication System	m Of IC Engine	CO3
		e timing diagram of 4 stroke petrol engine.		CO4
		etrol Engine Test Rig To Prepare The Heat Bala	nce Sheet And	CO4
' Plot	Performance Curve			
		he Petrol Engine Test Rig		CO4
		e timing diagram of 4 stroke diesel engine.	_	CO5
	Perform Load Test On Diesel Engine Test Rig To Prepare The Heat Balance Sheet And			CO5
Plot	Performance Curve			

Text	Books
T.1	Internal Combustion Engine by V Ganeshan, McGraw Hill Education Pvt. Ltd.
T.2	Internal Combustion Engine by R. K. Rajput, Laxmi Publication
T.3	Internal Combustion Engines by V. M. Domkundwar, Dhanpat Rai Publications (P) Ltd.
T.4	Internal Combustion Engine by M. L. Mathur and R. P. Sharma, Dhanpat Rai Publications (P) Ltd
Refe	rence Books
R.1	Internal Combustion Engines, E. Obert, Intex educational publication.
R.2	Internal Combustion Engine fundamental by John Heywood, Tata MCGraw Hill Publication

U	Useful Links		
	1	https://nptel.ac.in/courses/112104033	
	2	https://nptel.ac.in/courses/112103262	NAME OF THE PARTY

1) IK	Course Outcomes	CL
	Demonstrate the ability to safely assemble and dismantle a multi-cylinder petrol engine,	3
	Demonstrate knowledge of carburetors used in petrol engines, to aware importance in air-fuel mixture preparation.	3
	Analyze the engine cooling and lubrication systems of IC engines, to know their key components, functions,	3
BME33613.4	Evaluate the performance of a multi-cylinder petrol engine using the Morse test	3
BME33613.5	Summarize the performance characteristics of a diesel engine under varying load conditions, to find heat balance sheet and performance curves	5

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and Technology, Nagpur

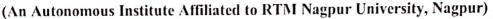


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Third Year (Semester-VI) B. Tech. Mechanical Engineering BME33614: Mechatronics & Robotics Lab Teaching Scheme **Examination Scheme** 2Hr/Week **Practical** CA 25 ESE 25 **Total Credits** 1 50 Marks Total Duration of ESE: 02 Hrs Course Objectives: To familiarize students with the identification and application of electronic components, sensors, and actuators used in Mechatronics systems To enhance the understanding of industrial automation by analyzing and executing automation task using 2 standard model To apply PLC programming concepts for automation tasks including bottle filling, lift control, and water 3 level management. To demonstrate the use of electro-pneumatic and hydraulic systems for motion control in industrial 4 To develop the ability to compare various industrial robots based on their configuration and 5 degrees of freedom. CO Name of Experiment Experiment no. Interpret the characteristics and functionality of solid-state electronic devices for classification CO₁ and application in electronic circuits. Selection of different types of sensors and actuators in mechatronic systems with its application. CO₂ 2 Develop a ladder logic program using PLC for a bottle filling plant as part of a Mechatronic CO₃ 3 Construct a ladder logic-based PLC program for a Water Level Controller and demonstrate its CO₃ 4 integration in a Mechatronic system. Implementation of ladder logic program using PLC for a Lift Control System in the context of CO₃ 5 Mechatronic automation. Demonstration of Electro Pneumatic Systems CO₄ 6 Demonstration of Electro Hydraulic Systems CO₄ 7 Comparative Study of Industrial Robots Based on Configuration and Degrees of Freedom. CO₅ 8 (Articulate, SCARA, Cartesian, Cylindrical, Delta) CO5 Study of Articulated Robot Configuration and Degrees of Freedom 9 Performance of Pick-and-Place Operation Using Articulated Robot CO₅ 10 Text Books Mechatronics - Integrated Mechanical Electronics System, K.P. Ramachandran, Wiley India Pvt. Ltd. T.1 New Delhi Mechatronics & Microprocessors, K.P. Ramachandran, Wiley India Pvt. Ltd., New Delhi T.2

Mechatronics, Bolton W, Pearson Education, Second Edition, 1999.

Reference E	Books
R.1	Pneumatic Tips, Festo K G, Festo, Germany, 1987
R.2	Mechatronics: Introduction, Robert H Bishop, Taylor and Francis, 2006.

	Useful Links
1	https://archive.nptel.ac.in/courses/112/107/112107298/
2	https://nptel.ac.in/courses/112103174

	Course Outcomes	CL
BME33614.1	Interpret the characteristics and functionality of solid-state electronic devices, to get classification, and application in electronic circuits.	3
BME33614.2	Illustrate the selection and application of sensors to, highlight their functionality and importance in system design.	3
BME33614.3	Demonstrate the ladder logic programming using PLC for automation.	3
BME33614.4	Demonstrate knowledge of electro-hydraulic systems, to gain knowledge of design and troubleshoot hydraulic circuits.	3
BME33614.5	Summarize the performance characteristics of articulated robots in pick-and-place operations, to influence their performance.	5

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