AUTOMOTIVE DESIGN AND MANUFACTURING ENGINEERING (INTERNATIONAL PROGRAM) (B.ENG)

Automotive design and manufacturing engineering are a highly demanded profession, which is linked to the national and global boosted growth of automotive industry. Automotive design involves the development of motor vehicles with a primarily concern on design of mechanical components and the creation of the product concept. Manufacturing engineering deals with all aspects of manufacture, from production control to materials handling to automation.

Our ADME graduates, being specialized, are trained in both automotive design and manufacturing engineering. Our program trains students to have a solid background in both fields with a flexibility to choose to specialize in either topic. This advantage doubles the job opportunities for our graduates, whilst serving the local and international automotive industry with qualified and versatile engineers with a broad academic background.

Each student is required to accumulate a minimum of 146 credits to graduate for Bachelor of Engineering Program in Automotive Design and Manufacturing Engineering (International Program) which also includes 2 credits of industrial training and 3 credits of senior project.

Curriculum board

Sunhapos Chatranuwathana	Ph.D. (Michigan)
Witaya Wannasuphoprasit	Ph.D. (Northwestern)
Surapong Sirikulvadhana	M.S. (Michigan)
Wanchalerm Pora	Ph.D. (London)
Prabhath De Silva	Ph.D. (USA)
Nuksit Noomwongs	D.Eng. (TUAT)

Professors

Mechanical Engineering

Pramote Dechaumphai	Ph.D. (Old Dominion)
Viboon Sangveraphunsiri	Ph.D. (Georgia Tech)

Associate Professors

Mechanical Engineering

Asi Bunyajitradulya	Ph.D. (UC Irvine)
Kuntinee Maneeratana	Ph.D. (London)
Kanit Wattanavichien	Ph.D. (Melbourne)
Ratchatin Chanchareon	D.Eng. (Chula)

Industrial Engineering

Somkiat Tangjitsitchareon	D.Eng. (Kobe Japan)

Metallurgical and materials Engineering

Seksak Asavavisithchai	Ph.D. (Nottingham)

Assistant Professors

Electrial Engineering

Wanchalerm Pora	Ph.D. (London)
Suree Pumrin	Ph.D.(Washington)

Mechanical Engineering

Boonchai Lertnuwat	Ph.D. (Tokyo)
Sunhapos Chantranuwathana	Ph.D. (Michigan)
Witaya Wannasuphoprasit	Ph.D. (Northwestern)
Nopdanai Ajavakom	Ph.D. (UC.Berkeley)
Niphon Wansophark	D.Eng. (Chula)
Alongkorn Pimpin	D.Eng. (Tokyo)
Chanat Ratanasumawong	D.Eng. (Tokyo Tech)
Thanyarat Singhanart	Ph.D. (Tokyo)

Industrial Engineering

Somchai Puajindanetr	Ph.D. (London)

Lecturer

Electrial Engineering

Boonchuay Supmonchai	M.Eng. (Chula)

Mechanical Engineering

Nuksit Noomwongs	D.Eng. (TUAT)
Chirdpun Vitooraporn	(MIT)
Tawan Paphapote	Ph.D.C.(USA)

Industrial Engineering

Oran Kittithreerapronchai	Ph.D. Georgia

ISE Staffs

Yan Zhao	Ph.D. (London)
Prabhath De Silva	Ph.D. (USA)

Guest lecturer

Somchai Peungperksuk	Ph.D.
Kaukeart Boonchukosol	Poitiers (Frence)

Visiting Professor (USA)

Stanley Peter Lynch	Ph.D. (UK)

Curriculum

Total number of credits requirement	144	credits
General Education	30	credits
Core Courses	108	credits
Basic Sciences	21	credits
Basic Engineering	28	credits
Compulsory	50	credits
Approved Electives	9	credits
Free Electives	6	credits

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1. General Education **30 credits**

Social Science	3	credits
Humanity	3	credits
Science and Mathematics	3	credits
Interdisciplinary	3	credits
Foreign Language	12	credits
5501112 Communicative English I		3(3-0-6)
5501123 Communicative English II		3(3-0-6)
5501214 Communication and Presentation Skills		3(3-0-6)
5501225 Technical Writing		3(3-0-6)
General Education (Special)	6	credits
2140111 Exploring Engineering World		3(3-0-6)
2183281 Introduction to Automotive Eng.		3(3-0-6)

2. Core Course **111 credits**

Basic Sciences	21	credits
2301107 Calculus I		3(3-0-6)
2301108 Calculus II		3(3-0-6)
2301312 Differential Equations		3(3-0-6)
2302103 General Chemistry Laboratory		1(0-3-0)
2302105 Chemistry for Engineers		3(3-0-6)
2304153 Physics for Engineers		3(3-0-6)
2304154 Physics and Electronics for Eng.		3(0-3-0)
2304193 Physics Laboratory for Eng.		1(0-3-0)
2304194 Physics and Electronics Laboratory for Engineers		1(0-3-0)
Basic Engineering	28	credits
2140301 Industrial Training		2(0-6-0)
2142232* Manufacturing Process for Automotive Engineering		3(3-0-6)
2182210 Electrical Circuit		3(3-0-6)
2182213 Electrical Circuit Laboratory		1(0-3-0)
2183101 Engineering Graphics		3(2-3-4)
2183212 Statics		3(3-0-6)
2184201 Probability and Statistics for Automotive Engineering		3(3-0-6)
2142344* Management for Automotive Industry		3(3-0-6)
2189101 Engineering Materials		3(3-0-6)
2190101 Computer Programming		3(3-0-6)
2190151 Computer Programming Laboratory		1(0-3-0)
Compulsory Courses	50	credits
2183221 Thermodynamics		3(3-0-6)
2183271 Automotive Engineering Workshop		1(0-3-0)
2142233* Engineering Project I		2(1-2-3)
2182234* Introduction to Signals and Systems		3(2-3-4)
2183213 Mechanics of Material		3(3-0-6)
2183231 Dynamics3		3(3-0-6)
2182322* Electronics and Instrument Engineering for Automobile		3(3-1-5)
2183323* Fundamentals of Fluid Mechanics and Heat Transfer		3(3-0-6)
2183261 Mechanical Engineering Laboratory		2(1-3-2)
2183324* System Modeling and Vibration		3(2-3-4)
2183332 CAD/CAM/CAE		3(2-3-4)
2142242 Vehicle Dynamics		3(3-0-6)
2184342* Engineering Project II		2(1-2-3)
2183351 Mechanical Engineering Design		3(3-0-6)
2184343* Modern Automotive Propulsion System		3(3-0-6)
2142498 Automotive Engineering Pre-Project		1(0-2-1)
2183426* Vehicle System Design		3(3-0-6)
2182430 System Dynamics and Controls		3(3-0-6)
2142499 Automotive Engineering Project		3(0-6-3)
Approved Electives	9	credits
2142352 Finite Element Methods and Applications		3(3-0-6)
2142422 Vehicle Aerodynamics		3(3-0-6)
2142423 Power Train Systems		3(3-0-6)
2142426 Noise, Vibration and Harshness		3(3-0-6)
2142428 Automotive Diagnostics and Maintenance		3(3-0-6)
2142433 Failure Analysis and NDT		3(2-3-4)
2142453 Concept Car Design		3(3-0-6)
2142461 Automation and Robotics		3(3-0-6)
2142488 Measurement, Instrumentation And Data Acquisition		3(3-0-6)
2142492 Selected Topics in Automotive Engineering I		3(2-3-4)
2142493 Selected Topics in Automotive Engineering II		3(2-3-4)
2142495 Independent Studies		3(0-6-3)
2182442 Embedded Systems in Automotive Engineering		3(3-0-6)
2182444* Power Electronics for Automotive Engineering		3(3-0-6)
2183431 Mechanical Vibrations		3(3-0-6)
2184405 Product Planning and Control		3(3-0-6)
2184406 Quality Control and Management For Automotive Industry		3(3-0-6)
2190445* Software Engineering for Embedded Systems		3(3-0-6)

3. Free Electives **6 credits**

Select 6 credits from any courses offered in English by any International Programs in Chulalongkorn University.

AUTOMOTIVE DESIGN AND MANUFACTURING

ENGINEERING CURRICULUM

(INTERNATIONAL PROGRAM)

(B.ENG)

COURSE NO.	SUBJECT	CREDITS
	FIRST SEMESTER	
2190101	Computer Programming	3
2190151	Computer Programming Laboratory	1
2301107	Calculus I	3
2302103	General Chemistry Laboratory	1
2302105	Chemistry for Eng.	3
2304153	Physics for Eng.	3
2304193	Physics Lab for Engineers	1
5501112	Communicative Eng I	3
		18
	SECOND SEMESTER	
2140111	Exploring Engineering World	3
2183101	Engineering Graphics	3
2189101	Engineering Materials	3
2301108	Calculus II	3
2304154	Physics and Electronics for Eng.	3
2304194	Physics and Electronics Lab for Eng.	1
5501123	Communicative English II	3
		19
	THIRD SEMESTER	
2142232*	Manufacturing Process Engineering for Automotive	3
2183212	Statics	3
2183221	Thermodynamics	3
2183271	Automotive Engineering Workshop	1
2183281	Introduction to Automotive Eng.	3
2184201	Probability and Statistics for Auto Eng.	3
2301312	Differential Equations	3
		19
	FOURTH SEMESTER	
2142233*	Engineering Project I	2
2182234*	Introduction to Signals and Systems	3
2182210	Electrical Circuit	3
2182213	Electrical Circuit Laboratory	1
2183213	Mechanics of Materials	3
2183231	Dynamics	3
5501214	Communication and Presentation Skills	3
		18

COURSE NO.	SUBJECT	CREDITS
	FIFTH SEMESTER	
2182322*	Electronics and Instrumentation for Automotive Engineering	3
2183323*	Fundamentals of Fluid Mechanics and Heat Transfer	3
2183261	Mechanical Engineering Laboratory	2
2183324*	System Modeling and Vibration	3
2183332	CAD/CAM/CAE	3
5501225	Technical Writing	3
		17
	SIXTH SEMESTER	
2142424	Vehicle Dynamics	3
2184342*	Engineering Project II	2
2183351	Mechanical Engineering Design	3
2184343*	Modern Automotive Propulsion System	3
2142344*	Management for Automotive Industry	3
xxxxxxx	General Education	3
		17
	SUMMER SEMESTER	
2140301	Industrial Training	2
	SEVENTH SEMESTER	
2142498	Automotive Engineering Pre-Project	1
2183426*	Vehicle System Design	3
2182430	System dynamics and control	3
xxxxxxx	Compulsory Elective I	3
xxxxxxx	General Education	3
xxxxxxx	General Education	3
xxxxxxx	Free Elective	3
		19
	EIGHTH SEMESTER	
2142499	Automotive Engineering Project	3
xxxxxxx	Compulsory Elective II	3
xxxxxxx	Compulsory Electives III	3
xxxxxxx	General Education	3
xxxxxxx	Free Elective	3
		15
	TOTAL CREDITS FOR GRADUATION	**144**

COURSES DESCRIPTIONS IN AUTOMOTIVE DESIGN AND MANUFACTURING ENGINEERING (B.ENG)

General Education

2140111 Exploring Engineering World 3(3-0-6)
Engineering topics related to daily life: energy, resources, environment manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering.

2183281 Introduction to Automotive Engineering 3(3-0-6)
Basic Principles of automotive systems, components, and design; internal combustion engine; transmission; chassis; suspension; steering; brake; body; vehicle aerodynamics and automotive electronics; basic vehicle dynamics; performance and handling.

5501112 Communicative English I 3(3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123 Communicative English II 3(3-0-6) Condition: PRER 5501112
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned and presenting opinions from group discussion.

5501214 Communication and Presentation Skills Condition: PRER 5501123 3(3-0-6)
Practice using English for social communication and giving oral presentation on engineering related topics.

5501225 Technical Writing 3(3-0-6) Condition: PRER 5501123
Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

Core Course

2301107 Calculus 1 3(3-0-6) Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals.

2301108 Calculus 2 3(3-0-6) Condition: PRER 2301107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three-dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2301312 Differential Equations 3(3-0-6) Condition: PRER 2301108
Existence and uniqueness theorem of solution of first order equations; initial value problem; Laplace transform; Taylor series expansion of elementary functions; numerical methods; general linear equations; solution in series; linear partial differential equations boundary value problems.

2302103 General Chemistry Laboratory 1(0-3-0)
Standard solution preparation; qualitative analysis; titration; electrochemistry, pH metric titration; spectroscopy; calculation and evaluation of data; calibration curve; introduction to polymer.

2302105 Chemistry for Engineers 3(3-0-6)
Stoichiometry and basis of the atomic theory; properties of the three states of matter and solution; thermodynamics; chemical equilibrium; Oxidation-reduction; chemical kinetics; the electronic structures of atoms and the chemical bond; periodic table; nonmetal and transition metal.

2304153 Physics for Engineers 3(3-0-6)
Mechanics of particles and rigid bodies; properties of matter; fluid mechanics; heat; vibrations and waves; elements of electromagnetism; optics; modern physics.

2304154 Physics and Electronics for Engineers 3(3-0-6)
Electricity DC circuits; AC circuits; basic electronics; electrical actuators.

2304193 Physics Laboratory for Engineers 1(0-3-6)
Measurement and precision; experiments on simple harmonic motion; radius of gyration; dynamics of rotation; velocity of sound; viscosity of fluids.

2304194 Physics and Electronics Laboratory for Engineers 3(3-0-6)
Resistance and electromotive force measurements; experiments on ammeter; voltmeter; oscilloscope; AC circuit; transistor; lenses and mirrors; polarization; interference; diffraction.

2140301 Industrial Training 2(0-6-0)
Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

2142232* Manufacturing Process for Automotive Engineering 3(2-3-4)
Introduction of automotive and parts manufacturing, product planning and manufacturing, System and process in automotive and parts manufacturing, Quality control in automotive parts manufacturing

2182210 Electrical Circuits 3(3-0-6) Condition: PRER 2304154
DC and AC circuit analysis; Kirchhoff's laws; Thevenin's and Norton's theorem; op-amps; digital circuit.

2182213 Electrical Circuit Laboratory 1(0-3-0)
Electronic instruments; multimeter; oscilloscope; DC circuit; Voltage regulators; filter circuit; transistor amplifier circuit; op-amp circuits; digital Circuits; DC motor.

2183101 Engineering Graphics 3(2-3-4)
Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; tolerancing and geometrical tolerancing; section; working drawing; mechanical parts drawing; introduction to CAD.

2183212 Statics 3(3-0-6)
Force systems; resultants; equilibrium; structure; distributed force; friction; virtual work; stability.

2184201 Probability and Statistics for Automotive Engineering 3(3-0-6)
Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: esto,atpr. Bias, consistency; point estimation; interval estimation; automotive engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in automotive engineering applications; case studies.

2142344* Management for Automotive Industry 3(3-0-6)

Study of modern management principle; Learn the methods of increasing productivity in automotive industry, human relation; industrial safety, commercial laws, basis of engineering economy, finance, marketing, project management in automotive industry

2189101 Engineering Materials 3(3-0-6)

Important engineering materials: metals, plastics, asphalt, wood and concrete; phase diagram and its interpretation; testing and meaning of various properties; macroscopic and microscopic structure which are correlating with properties of the engineering materials; production process of products from engineering materials.

2190101 Computer Programming 3(3-0-6)

Introduction to computer systems; problem-solving using computers; programming in high level languages; program structure, programming style and convention; control statements, data handling and processing; subprograms; classes and objects.

2190151 Computer Programming Laboratory 1(0-3-0)
Condition: COREQ 2190101

Computer programming in Engineering; reviews of computer programming concepts; hands-on experience on computer programming using contemporary Engineering tools.

2183221 Thermodynamics 3(3-0-6)

Basic concepts; thermodynamic state and process; properties of pure substances and ideal gases; energy; the first law of thermodynamics and the first law analysis for isolated, closed, and open systems; entropy; the second law of thermodynamics and the second law analysis for isolated, closed, and opens systems; gas power cycles; Carnot, Otto, and Brayton cycles; refrigeration cycle; introduction to gas mixtures; introduction to combustion.

2183271 Automotive Engineering Workshop 1(0-3-0)

Hand-on study of automotive systems and components; names and functions of components and parts; basic mechanical parts; engine; electronic systems; power train; brake systems; steering mechanism; basic diagnosis.

2142233* Engineering Project I 2(1-2-3)

Basic mechanical engineering knowledges in machine design: drawings, dimensioning, tolerance, machine components, simple mechanical machine layout and drawings, team work skills, mechanical machine project.

2182234* Introduction to Signals and Systems 3(2-3-4)

Continuous and discrete-time signals, sampling theorem, Fourier series, Laplace transform, z transform, transfer function, signal processing, open and closed-loop control, stability, control system design.

2183213 Mechanics Material 3(3-0-6)
Condition: PRER 2183212

Force and stress; stresses and strains relationship; Hooke's law; modulus of elasticity; stresses in beams; shear force; bending moment diagrams; deflection of beams; torsion; buckling of columns; Mohr's circle; combined stresses; failure criterion; safety factors.

2183231 Dynamics 3(3-0-6)

Kinematics of three-dimensional curvilinear motion of a particle; kinetics of a particle: force and acceleration, work and energy, impulse and momentum; kinematics of planar motion of a rigid body: absolute and relative motion analysis; kinetics of planar motion of a rigid body: absolute and relative motion analysis; kinetics of planar motion at a rigid body; force and acceleration, work and energy, impulse and momentum; introduction to kinematics and kineties of three-dimensional motion of a rigid body.

2182322* Electronics and Instruments for Automotive Engineering 3(3-1-5)

Basic electronics; introduction to microcontroller; basic instrumentation; application of different types of instrumentations to automotive systems.

2183323* Fundamentals of Fluid Mechanics and Heat Transfer 3(3-0-6)

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; steady incompressible flow. Modes of heat transfer: conduction, convection, radiation and applications of heat transfer, heat exchangers and heat transfer enhancement, boiling and condensation.

2183261 Mechanical Engineering Laboratory 2(1-3-2)

Experimentation and basic concepts; error and uncertainty analysis; measurement and instrumentation; data analysis; interpretation of experimental results; reporting of experimental results; basic experiments in solid mechanics, thermodynamics, fluid mechanics and basic engine testing.

2183324* System Modeling and Vibration 3(2-3-4)

ODE system modeling and simulations; System responses with Laplace Transform; Transfer function and frequency responses (Bode and Transmissibility); Application on vibrations of engine and suspensions.

2183332 Computer Aided Design/Computer Aided Manufacturing and Computer Aided Engineering 3(2-3-4)

Introduction to CAD/CAM/CAE, 3D solid modeling, design concepts and implementation; link to manufacturing interface.

2142424 Vehicle Dynamics 3(3-0-6)
Condition: PRER 2183231

Dynamics of motor vehicles; properties of pneumatic tire; suspension and steering mechanism; vehicle longitudinal dynamics; linear bicycle models; stability; linear engine models; pleasure in driving.

2184342* Engineering Project II 2(1-2-3)

Product development process; Product requirements and specifications; reverse engineering; use of CMM; product design by CAD.

2183351 Mechanical Engineering Design 3(3-0-6)

Fundamentals of mechanical engineering design; properties of materials; theory of filure; fatigue; design of basic machine elements; design project of a simple mechanical machine.

2184343* Modern Automotive Propulsion Systems 3(3-0-6)

Fundamentals of automotive propulsion systems. Internal combustion engine; Modern enhancement of ICE for performance and emission requirements. Performance and testing. Electric propulsion systems. Electric motors. EV, HEV, PHEV systems. Energy sources.

2142498 Automotive Engineering Pre-Project 1(0-2-1)

Preliminary study for automotive engineering; project formulation and proposal.

2183426* Vehicle System Design 3(3-0-6)

Systematic approach to automotive system design; space defining components; ergonomics; automotive safety; standard; regulations and homologation.

2182430 System Dynamics and Controls 3(3-0-6)
Condition: PRER 2182210

System dynamics modeling; responses; introduction to control systems; feedback control system characteristics; the performance of feedback control systems; the stability of linear feedback systems; essential principles of feedback; the root locus method; time-domain analysis and design of control systems; frequency response method; stability of the frequency domain and compensation; use of computer in the design of control systems.

2142499 Automotive Engineering Project 1(0-3-0)

Group or individual project on a subject related to automotive engineering and manufacturing.

2183352 Motor Vehicle Design 3(3-0-6)

Systematic approach to automotive design; space defining components; ergonomics; automotive safety and legal regulations.

2142422 Vehicle Aerodynamics 3(3-0-6)

Effects of vehicle design on aerodynamics; wind tunnel testing; boundary layers and wakes; friction and pressure drag; aerodynamic forces and moments; center of pressure and vehicle stability.

2142423 Power Train Systems 3(3-0-6)

Manual and automatic transmission; basic operation of transmission; peripheral components.

2142426 Noise, Vibration and Harshness 3(3-0-6)

NVH and its importance for automotive industry. Sources of sound and vibration. Noise quality. Acceleration. Velocity, displacement, and sound pressure/intensity. DB Scales. Introduction to vibration. Free and forced vibration response of one and two degrees of freedom systems. Methods for determining natural frequencies and mode shapes for multi-degrees of freedom systems. Vibration measurement and control. Suspensions mounting systems. Road Simulators and wind tunnels. Noise and vibrations standards

2142428 Automotive Diagnostics and Maintenance 2(1-3-2)

Basic knowledge in Automobile components and its functions; troubleshooting guides, diagnostic tools for automobiles; do-it-yourself car care; knowledge in schedule services, maintenances and repair; defensive driving techniques.

2142433 Failure Analysis and Nondestructive Testing 3(2-3-4)

Analysis and diagnosis of the causes of failure; physics of failure; concepts of reliability, the use of failure analysis as part of the design process, time based/related failure modes, safety factors; case studies; elimination of failures through proper material selection, treatment and use; case histories; examination of fracture surfaces; laboratory investigations of different failure mechanisms.

2142453 Concept Car Design 3(3-0-6)

Introduction to concept car design; design process overview; functional objectives; conceptual package development; product benchmarking process; interior system and application; power train anatomy and layout; wheels and tires system; suspension and chassis system; bodies construction design; design integration.

2142461 Automation and Robotics 3(3-0-6)

Basic automation systems, equipment, sensors, actuators, material handling system, robots and their applications.

2142488 Measurement, Instrumentation and Data Acquisition 3(3-0-6)

Basic electromechanical techniques used in modern instrumentation and control systems; use of transducers and actuators; signal conditioning, grounding, and shielding; signal processing and feedback control methods with emphasis on frequency domain techniques; low-level measurements; lock-in technique.

2142492 Selected Topics in Automotive Engineering I 3(2-3-4)

Selected interesting topics in automotive engineering

2142493 Selected Topics in Automotive Engineering II 3(2-3-4)

Selected interesting topics in automotive engineering.

2142495 Independent Studies 3(0-6-3)

Self-study on topics related to automotive engineering with consent of the instructor, the study may be theoretical or experimental in nature.

2142442 Embedded Systems in Automotive Engineering 3(3-0-6)

Microprocessor architecture; introduction to embedded systems; programming concepts in C; software engineering practices; buses; device drivers and interrupt; inter-process communication; real-time operating system; hardware/software co-design.

2182444* Power Electronics for Automotive Engineering 3(3-0-6)
Condition: PRER 2182210 (Electrical Circuit) or CF

Fundamentals of power electronics. DC-DC converters, DC-AC converters, AC-DC converters. Fundamentals of energy-storage technologies and power converters for EV, HEV and PHEV.

2183431 Mechanical Vibrations 3(3-0-6)

Analysis of system with single and multi-degree of freedom; torsional vibration; free and forced vibration; determination of natural frequencies of structures; discrete system; Model analysis; methods and techniques to reduce and control vibration; Lagrange's equations.

2184405 Product Planning and Control 3(3-0-6)

The role of production planning and control in the manufacturing system; strategic planning of manufacturing systems; demand forecasting; inventory control, planning, scheduling, and control of operation; capacity planning.

2184406 Quality Control and Management for Automotive Industry 3(3-0-6)

Introduction to metrology and characterization; principles of destructive and non-destructive testing as applied in automotive part manufacturing. Concept of quality control, quality improvement, quality assurance, quality management, cost of quality; quality management systems: ISO series; failure mode and effects analysis; basic quality control tools; statistical process control: control charts, process capability analysis, measurement system analysis, acceptance sampling plans.

2190445* Software Engineering for Embedded Systems **3(3-0-6)**

Concept of embedded systems, software development life cycle, requirements gathering, software design, software implementation, testing, software deployment, project management, software tools