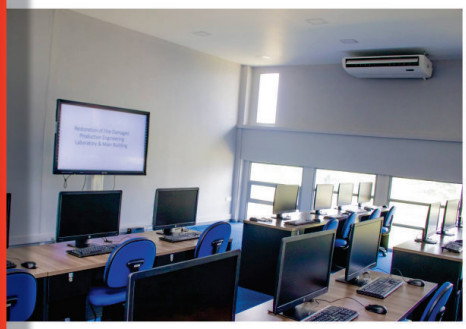
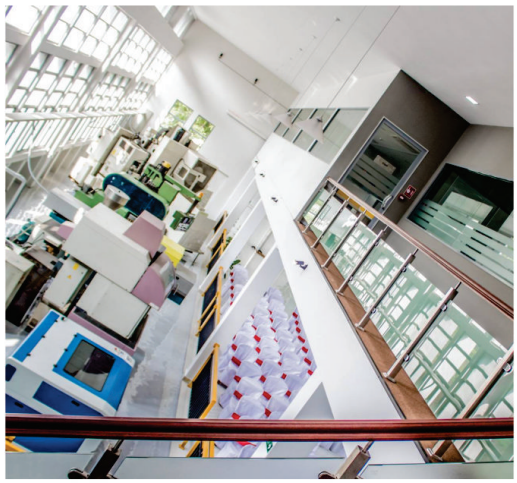
Department of
MANUFACTURING & INDUSTRIAL ENGINEERING
Faculty of Engineering
University of Peradeniya

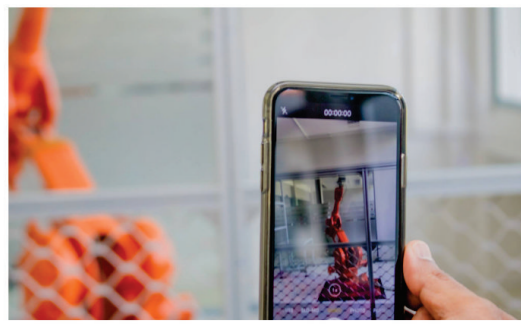
HANDBOOK









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HANDBOOK

Department of

Manufacturing & Industrial Engineering

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1. Introduction

1.1. Welcome Message from the Head of the Department

Welcome to the Department of Manufacturing & Industrial Engineering at University of Peradeniya. We started our journey in the year of 1978 as the first degree programme in Production/Manufacturing Engineering in Sri Lanka. Over the past four decades, we have grown our expertise and competence in the core Manufacturing & Industrial Engineering curriculum and research.

We have a strong undergraduate program in Manufacturing & Industrial Engineering in Sri Lanka. At the postgraduate level, we currently offer MEng, MSc in Engineering Management and Manufacturing Engineering Programmes and offer full-time/part-time postgraduate research degrees at MPhil, PhD levels in the areas of Manufacturing & Industrial Engineering.

Our department offers a science-based engineering curriculum where the primary focus is to impart technical know-how to students, promote their problem solving skills and innovation of new technologies and methodologies. Department offers large number of optional courses for providing a wide spectrum of options to the students to pursue their interest in Manufacturing and Industrial Engineering domains. The course contents are periodically updated for introducing new scientific and technological developments through the consultation of relevant stake holders. Undergraduate students are encouraged to undertake various research projects where majority of the research topics are selected from the manufacturing industry.

Our department maintains active research groups for carrying out collaborative and interdisciplinary research. We have state of the art laboratories, software, hardware and research facilities to support our academic programs and research. The academic staff have secured a number of research grants on competitive basis, and this research funding has helped us to maintain and modernize our research infrastructure.

Our department has a sound relationship with the manufacturing sector in Sri Lanka and has one of the strongest Industry Advisory Boards represented by top level officials from leading industries. Our department looks forward to contribute in solving the technological challenges of the Manufacturing & Industrial Engineering domains through active participation in collaboration with stakeholders.

Thank you very much for choosing us to enrich your career path.

Dr. A.K. Kulatunga

1.2. Vision of the Department

To be a center of excellence in higher education in the field of Manufacturing & Industrial Engineering.

1.3. Mission Statement of the DMIE

Teaching: To create an innovative, learning-by-doing experience for students focused on enhancing creative and analytical thinking, knowledge and skills in the manufacturing & industrial engineering discipline, lifelong learning, communication, positive attitude and respect for environment, ethics & sustainability.

Research: To create a work environment that can help cultivate a motivated, multidisciplinary research team who continuously produce research output with high impact and relevance in the field of manufacturing & industrial engineering.

Contribution to Society: To impact society in a positive and transformative manner by providing high quality services, consultancy and capacity building programmes to enhance the local manufacturing related industry and improve lives and livelihood.

1.4. Why Study Manufacturing and Industrial Engineering?

Manufacturing and Industrial engineering is about the combined art and science of designing, developing and managing the manufacture of quality products with advanced technology. Manufacturing Engineers engineer the processes and production systems to make virtually every kind of product from the beginning to the end. The industrial and manufacturing engineering team are responsible for both manufacturing technology as well as manufacturing systems. They are constantly challenged to use both innovation and imagination to find better ways to make the products that we need such as MP3 players, mobile phones, cars, planes, food, pharmaceuticals, in fact almost everything we come across are needed to be manufactured.

What do Manufacturing and Industrial Engineers do?

Manufacturing and Industrial Engineers design and develop the process that makes a product, always striving to meet the challenges of producing high quality products at the fast pace that our society now demands. They are concerned with developing processes and systems that improve quality and productivity in the manufacture of a product, while managing with the courses in technology and innovative solutions also assuring the health and safety issues with least environment impact.

1.5. Graduate Profile

The department aims to develop the profile of the graduate in two major complementary areas:

Technological mastery highlighting the skills of harnessing technological resources at all levels, with greater emphasis on activities at the shop floor level with a clear awareness of the strategic management implications;

Mastery of the management of technological resources with a greater emphasis on design and operation of manufacturing systems, working in close liaison with strategic management and enterprise management with a good knowledge of manufacturing technology.

The student is free to make his/her choice by selecting the optional courses appropriately. The core subjects are designed to suit both categories.

The Manufacturing and Industrial Engineering programme aims to provide graduates with the necessary knowledge, skills, and attitudes to be able to:

- Design innovative and competitive products, manufacturing processes and systems, placing high emphasis on quality, sustainability, reliability, safety, cost, ethical and social aspects.
- Define, analyze, evaluate, and solve complex problems related to manufacturing engineering, utilizing appropriate engineering methods and tools.
- Effectively participate as leaders and critical members of multidisciplinary teams with the ability to communicate technological concepts and details to a diverse audience.
- Conduct job specific research and development work by referring to relevant engineering literature.
- Engage in lifelong learning to enhance personal skills, advance professionally, and to enhance the quality of personal life.

The four-year bachelor's degree programme consists of a first year general programme followed by three years of specialization.

1.6. Career Opportunities

Earlier the department offered the specialized degree programme in Production Engineering. The name of the degree was changed to Manufacturing and Industrial Engineering exposing the students to a wide range of opportunities in the industry. Newly introduced curriculum contains both manufacturing processes as well as manufacturing systems to make well equipped graduates in the areas of Manufacturing Processes, Robotics & Automation, Mechatronics, Computer Aided Manufacturing, Production Planning, Simulation, Quality Engineering and Optimization. With this exposure our students are capable of beginning their career paths in emerging industries and our graduates have plenty of career opportunities in a much wider industrial sector. Currently our graduates are employed as Operations Engineers, Manufacturing Engineers, Automation Engineers, Design Engineer, Production Engineers research and Development Engineers, Innovation Engineers. Meanwhile some are serving the industry with their management skills being Production Managers, Supply Chain Managers, Operations Managers and Logistics Managers as well.

Being one of the seven departments in the Faculty of Engineering, the department actively directs and introduces the graduates to well-developed sustaining industries through the annual career fair organized by the faculty.

2. Background of DMIE

2.1. History

The industrial development of a country involves the setting up of many manufacturing processes, carried out in industrial units of varying sizes and varying levels of mechanization. The numerous processes that occur, the organization of manufacture, and the management of men and machines are subjects that do not fall within the scope of a course in Mechanical Engineering. In recognition of the need for special courses in this field proposals for a Department of Production Engineering were submitted by the Faculty in 1967. On obtaining approval from the NCHE, two Assistant Lecturers in Production Engineering were appointed in May 1968 and temporarily attached to the Department of Mechanical Engineering. (in fact the Mechanical Engineering Department would be called upon to act as guardian to all three new departments during their long drawn out and even stunted, adolescence). In due course these two Assistant Lecturers were sent abroad for their post-graduate training. The task of building up the new Department would be entrusted to them on their return in the early 1970s.no serious difficulties were anticipated in the early stages as this Department had the use of the Faculty Workshop as a base until its own, separate laboratories were ready. In the meantime, the Faculty was fortunate in obtaining two expatriate lecturers for this Department in 1971. One of them an experienced academic from United States, was supported by the Fulbright scheme, while the other was recruited directly from Britain. These two lecturers were able to give Production Engineering a start by organizing courses of lectures and by setting up a few basic laboratory experiments using the limited resources in those very austere years. The growth of this Department was seriously hampered by the lack of funds and it was only in 1978 that the degree in Production Engineering would be awarded for the first time- ten years after the launching of the Department.

2.2. Organization and Administration

Activities relating to organization and administration are handled by the Head of Department with the assistance of staff members who have been assigned specific responsibilities. The course coordinators organize practical work, industrial visits, projects, industrial training assessment, examination related records, etc. and attend to matters of students. The activities of the laboratories are supervised by the lecturers-in-charge of the respective laboratories and the technical officers are responsible for smooth functioning of the activities of their laboratories.

2.3. Contact information

Department Office:	
E-mail:	headmie@eng.pdn.ac.lk
Phone:	081-2393650
Fax:	081-2393655
Extension:	3650
Web Site:	http://eng.pdn.ac.lk/mie/
Head of the Department:	Dr. Asela K. Kulatunga
E-mail:	aselakk@eng.pdn.ac.lk
Phone:	081-2393658
Extension:	3658

2.4. Staff

Academic Staff

Head of the Department

Asela K. Kulatunga
BScEng Peradeniya, PhD UTS, SMIISE (USA), MIEEE (USA), MPOMS (USA), CMCILT (UK), AMIESL

T.P No(Ext) : 3658
Email : aselakk@pdn.ac.lk, aselakk@eng.pdn.ac.lk

Research & Teaching Responsibilities
Industrial Engineering
Logistics and Supply Chain Management
Sustainable Manufacturing
Industry 4.0 for Manufacturing Systems

Professor

S.D. Pathirana
BScEng Sri Lanka, MSc RUGhent,
DEng Tokyo, MIEEE, CEng, MIET, FIE SL.

T.P No (Ext) : 3958
Email : susp@pdn.ac.lk
susp@eng.pdn.ac.lk

Research & Teaching Responsibilities
Parameter Optimization in Metal Cutting
Precision Machining Strategies/Algorithms
Robotics & Automation – Mobile Robots
Modelling & Control of Dynamic Systems
(Pneumatic Artificial Muscles, Servo Drives.)
Design & Manufacture of Bio-medical prosthesis

Senior Lecturers

N.K.B.M.P. Nanayakkara
BScEng Peradeniya, PhD Deakin

Email : *manjulan@pdn.ac.lk*
manjulan@eng.pdn.ac.lk

Research & Teaching Responsibilities
Metal Forming
Surface Engineering
Manufacturing Process Improvements

R.A. Ekanayake
BScEng Peradeniya, PhD UNSW

T.P No (Ext) : 3964
Email : *risheekae@pdn.ac.lk*,
risheekae@eng.pdn.ac.lk

Research & Teaching Responsibilities
Analysis of machining operations
High speed machining
Quality improvement of manufacturing operations,
Casting (Brass), Forming
Re-use of PET materials
Manufacturing planning and control

C.D. Senanayake
BScEng Peradeniya, PhD NUS

T.P No (Ext) :
Email : *cds@pdn.ac.lk*
cds@eng.pdn.ac.lk

Research & Teaching Responsibilities
Modeling and Analysis of Manufacturing Systems
Stochastic Processes
Simulation

P. Gamage
BScEng Peradeniya, PhD Massey

T.P No (Ext) : 3961
Email : *pramilag@pdn.ac.lk*
pramilag@eng.pdn.ac.lk

Research & Teaching Responsibilities
Design of Experiments (DOE)
Statistical Process Control
Six Sigma
Lean Thinking

W.A.R. Manamperi
Post Doctoral Fellow, North Dakota State University, USA, Ph.D., USA, M.Sc. Moratuwa, B.Sc. Eng. Moratuwa

T.P No (Ext) : 3959
Email : *asangam@pdn.ac.lk*
asangam@eng.pdn.ac.lk

Research & Teaching Responsibilities
Applications in bio-polymers in comodity plastics,
Use of high-volume, low-value in fiber sources in bio-based materials
Sustainable manufacturing in product innovations

Lecturers

M. Dharamawardhana
BScEng Peradeniya, MSc NFU

T.P No (Ext) : 3960
Email : *mahad@pdn.ac.lk*
mahad@eng.pdn.ac.lk

Research & Teaching Responsibilities
CAD/CAM
Plastic Manufacturing
Additive Manufacturing

A.M.B.G.D.A. Athauda
BScEng Peradeniya

Email : *dharshanaa@pdn.ac.lk*
dharshanaa@eng.pdn.ac.lk

Research & Teaching Responsibilities
Modeling and identification of robotic systems
Control of autonomous vehicles (Unmanned Aerial Vehicles Unmanned Ground Vehicles)
Manufacturing Automation

H.M.M.M. Jayawickrama
BScEng Peradeniya

Email : *malanj@pdn.ac.lk*
malanj@eng.pdn.ac.lk

Research & Teaching Responsibilities
Sustainable Manufacturing
Lean Manufacturing
Industrial Engineering
Operation Management

W.M.S.B. Kumarasinghe
BScEng Moratuwa

Email : *subhanibk@pdn.ac.lk*
subhanibk@eng.pdn.ac.lk

Research & Teaching Responsibilities
Additive Manufacturing
Metallurgy
Non-Destructive Testing

Research Assistants

- Ms. T. Ranasinghe
- Mr. S. D. R. Lakmal
- Mr. M.P.R.L Peiris
- Mr. K.Sivapprakasam
- Mr. W. A. A. S. Premarathna
- Mr. M. L. R. Meragalge
- Ms. Nimasha Fernando
- Ms. Sumedha Amaraweera

Instructors

- Ms. H. K. I. C. Hapuarachchi
- Mr. A. C. Subasinghe
- Mr. G. K. J. P. Sumanathilake
- Mr. I. H. D. Wijerathne
- Mr. T. H. S. C. Thalagala
- Mr. L. A. D. A. D. Bandara
- Mr. N. G. T. P. Jayawardana
- Mr. N. M. S. S. B. Karunatilake
- Mr. D. A. Wickramaarachchi

Non-Academic Staff

Mr. M. R. K. G. Piyatissa (B.Sc. in Physical Science, Peradeniya)
Technical Officer Grade II

Mr. H. A.A. R. Wijetissa
Technical Officer Grade II

Mrs. A. K. Basnayake (B.Sc. in Business Administration, Sri Jayewardenepura)
Management Assistant Grade III

Mr. R. M. A. P. Kumara
Instrument Mechanic Grade II

Mr. H. P. D. S. Niranjana
Mechanic Grade II

Mr. K. M. Bandula Banda
Works Aid Grade I

2.5. Equipment and Facilities

The department has a wide range of equipment providing experimental facilities to students and staff members to carry out practical work, research, development and teaching. Currently available facilities and equipment are as follows:

Additive Manufacturing (Innovation) Laboratory

Our Innovation Lab consists of equipment which can be used in Additive Manufacturing including 3D scanning as well. The lab consists of three desktop size fused deposition modeling machines along with one Stereo lithography machine with adequate facilities for reverse engineering as well.

3D Printers

- Extrusion based
- Makerbot Replicator
- Ultimaker 2.0 Extended Plus
- Type A - Series 1 Pro
- Vat Photopolymerization XFab printer
- 3D Scanner - Einscan Pro

Ultimaker 2.0 Extended Plus

Type A - Series 1 Pro

Vat Photopolymerization XFab printer

3D Scanner - Einscan Pro

Advanced Machining Laboratory

This lab contains two CNC Machining Centers (3 and 4 axes respectively), CNC Turning Center, CNC Wire cut EDM Machine. These facilities are currently used for undergraduate and postgraduate teaching and research purposes as well as for industry consultancy assignments.

CNC Machining Center
Manufacturer: Okuma
No. of Axes: 4
Automatic Tool Changer: 20 Tool
Working area: 1200 x 630 mm

CNC Turning Center
Manufacturer: Okuma
No. of Axes: 4

Automatic Tool Turret capacity:
12 stations with axial and transverse milling facility
Center to Center distance: 1000mm
Swing over the bed: 300mm

CNC Wire Cut EDM
Manufacturer: Ona Prima
No. of Axes: 4
Accuracy:0.001mm

Automation Laboratory

Automation laboratory in the department is deliberately designed to provide the basic knowledge and skills in industrial automation and control. The laboratory is equipped with basic industrial sensors, servo motor drivers, programmable logic controllers (PLCs), industrial robots and an advanced computer integrated manufacturing system.

ABB IRB 2400 Robot

IRB 2400/10 is a 6-axis industrial robot manufactured by ABB Automation company. This high performance industrial robot uses a IRC5 Single Cabinet controller to control a payload of maximum 12 kg.

Basic Electro-Pneumatic Trainer Kit

Basic Electro-Pneumatics Training kit consists of an air compressor, pneumatic valves, pneumatic actuators, a power supply unit and a table top mounting frame. This is used as a training station for students in order to provide hands on experience on elementary electro-pneumatic control.

Basic Electro-Hydraulics Trainer Kit

Basic Electro-Hydraulics Trainer Kit is designed to provide hands on experience on elementary electro-hydraulic control systems. The trainer kit consists of hydraulic valves, industrial sensors, hydraulic actuators, pressure gauges and a table top mounting frame.

Basic Electro-Pneumatics Training kit

Electro-Hydraulics Trainer Kit

ABB IRB 2400 Robot

Metrology Laboratory

Surface Roughness Measuring System – Mitutoyo SV-2100

The system is a stylus-type surface roughness measuring system, which is capable calculating surface roughness and waviness based on various types of roughness standards, displaying measured results on a touch panel and print out the results on a recording paper. Mechanism of this system is that the stylus of the detector traces the surface of work the piece and detects fine asperity, and calculates surface roughness from vertical displacement and traverse movements of the stylus. Subsequent results displayed on the LCD screen monitor.

Specifications as follows;
Standards: JIS1982, JIS1994, JIS2001, ISO1997, ANSI, VDA.
Minimum Resolution: 0.000125µm

QM Height Gauge - Mitutoyo 518

The QM Height is a precision measuring instrument. The QM Height measuring heights as well as step inside/outside widths, inside/outside diameters, circle pitch and also measures free from surface max/min heights and height difference by scanning measurements. The measurement system based on an absolute electromagnetic induction linear encoder.

Specifications as follows;
Minimum Resolution: 0.001mm/0.005mm.
Accuracy at (20 0C): +/- (2.4+2.1L/600)µm

Laser Scan Micrometer (LSM) - Mitutoyo 9506

LSM is a non-contact optical measuring system and it's capable of measuring work pieces which are difficult to measure with conventional measuring instruments. It performs simple and accurate measurement of brittle or elastic objects, objects at high temperature, objects which must be kept clean, and soft objects which may be deformed and suffer dimensional changes under the measuring forces used.

Specifications as follows;
Measuring Range: 0.5mm – 60mm.
Minimum Resolution: 0.05 µm - 100 µm

Profile Projector – Mitutoyo PJ-H30A

The profile projector is a multi-purpose measuring projector for factory inspection use. It can perform precision measurement of work piece dimensions, contours and surface features. For example, routine inspection tasks in electronic and electrical parts processing, plastic molding, tool grinding and medical components manufacturing.

Specifications as follows;

Measuring Range: +/- 3600 (Counter display is up to +/- 3700). Minimum Resolution: 10 or 0.010

CNC Coordinate Measuring Machine (CMM)

Manufacturer: Mitutoyo
Model: Apex 707

Injection Moulding machine

The fully hydraulic BOY T50 Injection Moulding machine is currently being used for undergraduate teaching and experiments. It is having a clamping force of 50 Ton and 96cm3 shot capacity.

Laser Engraving and Cutting Machine

This machine has the capability of processing wood, paper, acrylic, glass, etc..and currently being used for undergraduate teaching and experiments and for Industry requirements.

Computer Integrated Manufacturing (CIM) Unit

CIM unit is specifically designed to demonstrate computer integration of a small-scale manufacturing system. The unit consists of a small-scale CNC machining center, two Mitsubishi robots with independent control, conveyer with an integrated PLC control unit and a demonstration program.

Student's Project Room

Students' Project Room is reserved as a supportive facility for the students who involving project-based activities and group activities. There students have the freedom in utilizing tools and equipment of the department under the supervision of the instructors and technical officers.

Computer Center

The computing center equip with 28 workstations. These are available to use for the student's practical's and for research and project works. The license versions of the commercial/ Educational software's:

SolidWorks/ SolidCAM, FactoryCAD, RoboExpert, Factory Flow, Arena, Simul8 avaible in the lab.

2.6. Working Hours and Access to Facilities

Normal working hours are from 8.00 am to 6.00 pm on week days. Usually laboratory facilities are available up to 7.45 pm. When necessary Laboratory facilities are provided on Saturdays as well. Students are allowed to handle laboratory equipment only under the supervision of instructors or laboratory technical officers.

Computer laboratory can be used from 8.00am to 7.45pm on weekdays

3. Degree Programme and Administration

3.1. Structure of Degree Programme

The General Programme in Engineering, which is conducted in the first academic year, is a common programme for all the students at the Faculty of Engineering.

Students are chosen to different fields of specialization at the end of the General Programme of Engineering, based on his/her preference to a particular field of specialization. In case of many students wanting to follow a particular field of specialization, priority of allocation will be given to students with higher overall performance in the General Programme in Engineering.

During the second, third and fourth years, the engineering students follow the Specialization Programme to which they have been chosen at the end of their first year of study. During these years, they follow courses recommended for their respective fields of specialization and an industrial training in the industry for a period of 20-24 weeks, as specified in the Rules and Regulations given. These courses are grouped in to two major categories as core courses and elective courses.

Core courses comprise taught courses, research projects, design work, laboratory and field work and they contribute to about 75% of the total credits earned during these years. Core courses are specific to the chosen field of study, and are compulsory. Research projects are open-ended projects carried out by an individual student or by a small group of students under supervision.

Elective courses are divided in to technical elective courses and general elective courses. Technical electives are designed to give a deeper understanding of some selected areas within the core or to provide technical knowledge to supplement the core, and are opened to the choice of the students. General elective courses are non-technical courses from outside the field of engineering.

3.2. Students' Records

Records relating to the students are maintained at various divisions of the University as described below:

Registration Information: Undergraduate unit of Dean's office

Examination Results: Examination and Academic Division

Welfare and Scholarship information: Students Welfare Division

4. Curriculum and Courses

4.1. Curriculum

Full information of the courses are as follows.

4.2. Core Courses

Semester 3

Course Code	Course Title	Category	Credit
CE201	Mechanics of Materials I	Core	3
EE280	Introduction to Electrical Engineering I	Core	3
EM201	Mathematics III	Core	3
ME211	Mechanics of Machines	Core	3
ME213	Computer Aided Drafting and Solid Modeling	Core	3
PR204	Product Design and Development	Core	3

Course Code	:	PR 204
Course Title	:	Product Design and Development
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims: To provide students' knowledge and understanding of different aspects of product design and development, ergonomic principals and material selection techniques so that they will be able to follow a structured approach in the invention/innovation of products.

Learning Outcomes: At the end of this course, students should be able to:

- Write a design brief for a given product initiative.
- Prepare the design specifications by using Quality Function Deployment which ensures that customers' requirements are met and takes into account the products of competitors.
- Create concept designs and select the optimum design by using standard evaluation techniques.
- Select the material, processes and calculate necessary forces, critical areas, sizes, stresses and analyze the design for the above design specifications.
- Generate the detailed drawings for a given product.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		50
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Why we need product designs Who designs and develops products Challenges of product development Standards Generic product development process Steps of product design	02			03
2	Motivation or Need Stage and Design Brief: Identifying customer needs, design brief, design specifications Quality Function Deployment (QFD)	04			03
3	Concept Design: Brainstorming Synaptic Objective trees Morphological charts Weighted objective method	06			04
4	Embodiment Design: Product architecture, parametric design, analysis, optimization Aesthetics Process selection	05			04
5	Detail Design, Documentation, and Development: Important features in part drawings, assembly drawings, and layout drawings, prototyping techniques and methodologies	02		03	04
6	Ergonomics: Posture, anthropometrics, Working environment	05			04
7	Material Selection: Mechanical behaviors, failures Performance indices, Ashby charts	06	01		03
	Total (hours)	30	01	03	25

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Semester 4

Course Code	Course Title	Category	Credit
CE207	Materials Science I	Core	3
EE281	Introduction to Electrical Engineering II	Core	3
EM202	Mathematics IV	Core	3
PR205	Machining Technology	Core	3
ME209	Machine Design I	Core	3
PR206	Manufacturing Planning and Control	Core	3

Course Code	:	PR 205
Course Title	:	Machining Technology
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims : To give students an understanding of the basics of mechanics of machining and different machining processes so that they would be able to analyze and select appropriate processes/ machines for manufacturing a specific product.

Learning Outcomes: At the end of this course, students should be able to:

- Describe the chip formation process with possible variations and illustrate the temperature distributions during the metal cutting action.
- Measure and analyze cutting forces during metal cutting.
- Describe different operations that can be performed on the lathe, milling and grinding machines and select appropriate operations/machines after technical/economic analysis to machine a given product.
- Describe types of tool wear and tool failure and calculate optimum cutting speeds for turning, milling, and grinding operations.
- Perform basic machining operations on lathe, milling, and drilling machines including gear manufacturing, and realize machining to desired tolerance boundaries.
- Describe the main components of NC architecture and write a simple part programme for a basic CNC machining operation.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction to Traditional and Non-Traditional Machining Techniques	02			
2	Metal Cutting: Oblique and orthogonal cutting Mechanics of chip formation Temperature in metal cutting	03	01		
3	Mechanics of Machining: Cutting forces, Power Cutting force analysis Force measurements, Dynamometry	03		03	
4	Lathe Operations and Milling Operations: Machine specifications Lathe Operations Milling operations Machining for assemblies Gear manufacturing methods	10	02	12	01
5	Abrasive Machining: Grinding operations, analysis Design considerations Surface finish and integrity	04		03	01
6	Tool Life, Wear and Failure: Types of tool wear, tool failure	02			01
7	Machining Economics: Economic cutting speeds for Lathe, Milling, Grinding operations	02	01		
8	Introduction to NC Technology: NC technology and architecture Introduction to part programming	03	01		01
	Total (Hours)	29	05	18	04

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Course Code	:	PR 206
Course Title	:	Manufacturing Planning and Control
Credits	:	3
Prerequisites	:	EM 201
Core/Elective	:	Core Course

Aims : To give students knowledge and understanding on the basic principles of manufacturing planning and control so that they can apply these principles to plan and control real manufacturing environments.

Learning Outcomes: At the end of this course, students should be able to:

- Analyze historical product demand data, develop demand forecasts and calculate the forecasting errors using both mathematical tools and statistical software.
- Describe the main factors to be considered for facility locations and use mathematical tools to locate them.
- Construct plant layouts and process plans for a given product using tools such as Systematic Layout Planning, precedence diagrams, and operation charts.
- Prepare aggregate plans, Master Production Schedules (MPS), and materials requirement plans for given bill of materials and product demand data.
- Solve basic job shop scheduling problems with dispatching rules and two machine flow shop scheduling using Johnson's algorithm and standard scheduling software.
- Develop the basic models applicable to inventory management, including EOQ, models accounting for quantity discounts, lot-for-lot and periodic order lot sizing rules.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction to Manufacturing Planning and Control: Hierarchical models of manufacturing planning and control Strategic, tactical, and operational level planning	02			
2	Strategic Planning: Demand forecasting techniques Manufacturing process planning Capacity and workforce planning Facility location Plant layout design	18	02	03	01
3	Tactical Planning: Aggregate planning Master production scheduling Materials requirements planning (MRP)	04			
4	Tactical and Operational Planning and Control: Scheduling of manufacturing resources Introduction to inventory management Inventory classification Inventory models (EOQ, Lot sizing)	12	02	03	
5	Group Project				03
	Total (hours)	36	04	06	04

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

Semester 5

Course Code	Course Title	Category	Credit
CE301	Mechanics of Materials II	Core	3
EE380	Electrical Power & Machines	Core	3
PR314	Manufacturing Automation	Core	3
ME306	Control Systems	Core	3
PR315	Manufacturing Systems	Core	3

Course Code	:	PR 314
Course Title	:	Manufacturing Automation
Credits	:	3
Prerequisites	:	EE 280, EE 281
Core/ Elective	:	Core Course

Aims : To enhance students' knowledge and understanding on the principles of industrial automation in designing/developing manufacturing systems in industry so that they will be able to implement algorithms/controllers in PC/Microcontroller/PLC and verify desired performance of an automated manufacturing system.

Learning Outcomes: At the end of this course, students should be able to:

- Design and assembly of automated systems with appropriate sensors, actuators and control elements.
- Verify system performance through implementation and testing as the last stage.
- Use interfacing techniques of sensors, actuators and control elements in controller implementation and testing.
- Be equipped and resourceful in the use of the devices during the assembly of manufacturing systems.
- Undertake tasks in assembling systems connected with programmable devices, sensors and actuators in realizing desired performance specifications.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Automation and automated manufacturing systems Hardware and software in automation Sensors, actuators and cell controllers Integration: Networking and data communication	03			
2	Sensors and Actuators: Encoders, Resolvers, IR and Ultrasonic, Laser Range Finders (LRF), Inertial Measurement Units (IMU), Accelerometers; Sensor fusion and localization Actuators: AC/DC servo drives, Hydraulic/Pneumatic drives	05	01	04	01
3	Technology of Manufacturing Automation: Computer Numerically Controlled (CNC) unit, organization of a CNC unit, drives and feedback devices, positional servomechanism, trajectory generation for CNC machines.	08	01	04	
4	Programmable Devices: Microprocessor/ microcontroller fundamentals (architecture and instruction processing, interfacing and communication with real world devices) Programmable Logic Controllers (architecture, Ladder diagram, I/O modules and interfacing, programming)	08	02	08	01
5	Manufacturing System Integration: Work-cell architecture, interfaces and networking; Industrial Fieldbus systems	06		04	
	Total (hours)	30	04	20	02

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Course Code	:	PR 315
Course Title	:	Manufacturing Systems
Credits	:	3
Prerequisites	:	PR 206
Core/ Elective	:	Core Course

Aims : To enable students to understand the underlying principles of modern manufacturing systems so that they can plan, control and manage manufacturing systems effectively.

Learning Outcomes: At the end of this course, students should be able to:

- Explain how the different modules of manufacturing planning and control are related in Manufacturing Resource Planning (MRP II) and Enterprise Resource Planning (ERP) systems software.
- Describe the main elements and different types of Computer Integrated Manufacturing (CIM) systems and Flexible Manufacturing Systems (FMS) and draw layout configurations of FMS.
- Evaluate the different shop floor control policies based on their perceived advantages/disadvantages.
- Model and solve extended inventory control problems including reorder point interactions, and extended job shop and flow shop scheduling problems using exact and heuristic methods.
- Describe the main tools used in Lean Manufacturing and explain how they can be utilized to improve manufacturing systems performance.
- Analyze the impact of variability on manufacturing system performance using simulation and analytical methods.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Integrated Manufacturing Systems: Manufacturing Resource Planning (MRP II) Computer Integrated Manufacturing Systems (CIM) Flexible Manufacturing Systems (FMS) Enterprise Resource Planning (ERP)	06	01	03	
2	Advanced Topics in Planning and Control: Extended models of inventory control (newsvendor model, reorder point) Extended models of flow shop scheduling problems	08	01		
3	Shop Floor Control Systems: Push and pull production WIP control policies Production tracking	06	01		
4	Introduction to Lean Manufacturing Systems: Lean tools Time and method study Line balancing	10	01	03	
5	Performance Evaluation of Manufacturing Systems: Performance measures Variability and performance Simulation modeling of manufacturing systems	06		03	01
	Total (hours)	36	04	09	01

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

Semester 6

Course Code	Course Title	Category	Credit
ME302	Machine Design II	Core	3
PR316	Forming Processes	Core	3
PR317	Quality & Reliability Engineering	Core	3

Course Code	:	PR 316
Course Title	:	Forming Processes
Credits	:	3
Prerequisites	:	CE 201, CE 207
Core/ Elective	:	Core Course

Aims : To improve the knowledge of students on metal forming and related topics so that they can solve problems related to industrial forming applications.

Learning Outcomes: At the end of this course, students should be able to:

- Calculate the material properties based on experimental results, suggest ways of improving material properties as per the requirement or decide the suitability of materials for given metal forming process/ product and analyze metal forming processes mathematically and optimize process parameters.
- Determine requirements for a given product including functional and geometric features and calculate the metal forming process parameters and procedures to manufacture the given product including design of metal forming dies, tooling and presses.
- Analyze requirements in forming nonmetals and design injection moulding dies, derive process parameters to manufacture a given product and design dies for injection moulding and control the injection moulding machines to satisfy given product requirements.
- Demonstrate life-long learning on metal forming related topics, aiming for professional development while engaging in metal forming related engineering process with good team working and interpersonal skills.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Introduction to metal forming, comparison with other manufacturing processes and selection of metal forming as a manufacturing process	02			
2	Revision on Materials and their Properties for Metal Forming: Mechanical and physical properties of materials for metal forming applications; stress-strain curves, yield criteria, strain hardening, hardness, hot and cold working, enhancement of material properties; alloying and heat treatment, coating, texturing, structural properties, processing of materials and applications	02		03	
3	Metal Forming Processes: Explanation of processes, material flow and control, classification of metal forming, forming limits, sheet and bulk forming methods, forming process parameters	02	01		
4	Bulk Forming Processes: Rolling, forging, extrusion, and wire drawing processes, mathematical analysis, process conditions and industry applications	06	01		01
5	Sheet Metal Forming: Stamping, deep drawing, stretch forming, sheet bending, channel forming and hydroforming methods, mathematical analysis of sheet forming processes, shearing, blanking, piercing, and trimming processes, tooling and press design for sheet forming processes, industry applications	06	01	03	01

6	Powder Forming: Powder forming applications and processes, mechanical alloying metal foams; structure and applications in aerospace and biomedical industry	03	01		
7	Casting of Metals: Casting of metals, types of mould and processes, solidifications of castings, inspection and defects in casting, casting design	06		03	01
8	Forming and Shaping of Non-Metals: Forming of plastics and composite materials, rapid prototyping, forming and shaping of ceramics and glasses, injection moulding, blow moulding, design and manufacture of die mould for plastics and rubber	05	01	03	01
	Total (hours)	32	05	12	04

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Course Code	:	PR 317
Course Title	:	Quality and Reliability Engineering
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims : To enhance students' knowledge on quality and reliability engineering related topics so that they can analyse and solve industrial problems to improve the quality and reliability of products, manufacturing processes and systems.

Learning Outcomes: At the end of this course, students should be able to:

- Explain the importance of quality as a manufacturing concept and discuss the significance of quality for products and processes.
- Evaluate metrology as a quality engineering aspect, determine dimensional standards of limits, fits and tolerances and be skillful in using modern metrological instruments for industrial applications.
- Derive and use control charts, comment on the statistical control of processes and define process capability.
- Demonstrate ability to refer to local and international standards on quality, apply and be resourceful in improving products and processes as per local and international standards.
- Define and apply maintenance strategies for manufacturing related processes.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Introduction to quality (definitions), dimensions of quality Quality gurus and concepts (Deming, Crosby, Juran, etc.) Evolution of quality, phases of quality engineering: quality planning, quality assurance and quality control	03	01		
2	Variability: Categorization of total variation in a system [Measurement system variation (Gauge R&R study) and product or process variation (special and common)] Control Charts (attribute and variable), Process capability Introduction to conventional view of quality (Goal Post Approach) and Taguchi's Philosophy on Quality Introduction to Cost of Quality	06	01	03	01
3	Quality Engineering: Quality Tools (7 control tools) Management aspects of quality (Introduction to Total Quality Management (TQM), Six-Sigma, and DFSS) Introduction to Robust design [Design of Experiments (DOE), Response Surface Methods (RSM), Taguchi's approach]	06	01	06	01
4	Metrology: Engineering metrology for assessing quality and conformance of products, international standards of limits, fits and tolerances, interchangeability, modern measuring instruments, introduction to Coordinate Measuring Machine (CMM)	06	01	03	
5	Reliability of Machines: Reliability engineering, machine standards, axis selection, accuracy standards, ISO 230, ISO 10796, ISO 941 standards	05			

6	Reliability of Processes: Maintenance strategies, preventive maintenance, effects of maintenance on quality, Overall Equipment Effectiveness (OEE), quality as a tool for improving OEE, Total Productive Maintenance (TPM), ISO 9000 series and applications	05	01	03	01
	Total (hours)	31	05	15	03

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

Semester 7

Course Code	Course Title	Category	Credit
PR404	CAD/ CAM	Core	3
PR408	Industrial Engineering & Decision Sciences	Core	3
PR410	Manufacturing Engineering Project I	Core	3

Course Code	:	PR 404
Course Title	:	CAD/
CAM **Credits**	:	3
Prerequisites	:	PR 204
Core/ Elective	:	Core Course

Aims : To give students a basic understanding of the product cycle, hardware and software environment of Computer Aided Design/ Manufacturing (CAD/CAM) and necessary tools and techniques of CAD/CAM so that they will be able to design a total manufacturing solution for a given product and/or enhance the performance of a manufacturing entity.

Learning Outcomes: At the end of this course, students should be able to:

- Describe the product cycle and identify the CAD and CAM operations within the product cycle.
- Identify the major components of a CNC machine.
- Model a new concept or product by means of CAD tools and analyze the product by means of Finite Element method.
- Choose the suitable CAD/CAM software and CNC machines for a given product.
- Generate the part programs for a given product.
- Use the CNC milling and turning machines to machine a given part.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Challenges in manufacturing, history of CAD/CAM, product cycle, definition of CAD and CAM tools	02			
2	CAD/CAM: Hardware: (Computer hardware, machine tools and components, hardware integration and networking) Modern technology of CAD/CAM Evaluation criteria	03			
3	Geometry/ Mathematical Representation: Curves, surfaces, solids, parametric representation Manipulations and applications Data exchange (Formats: IGES, DXF, STEP, PDES, etc.)	05	01	03	
4	Graphical Data Representation: Graphics standards, software modules, modeling and viewing, database, coordinate systems, transformations Manipulations and editing operations, primitives Algorithms for drawing entities Animation interactive programming	05	01		01
5	FEM/ Modeling and Analysis: Modeling and mesh generation Design and application	05	01	03	01
6	Software: Manual/computer aided part programming and manufacturing Code generation Tool path and verification machining Additive manufacturing	09	01	12	04
	Total (hours)	29	04	18	06

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Course Code	:	PR 408
Course Title	:	Industrial Engineering and Decision Sciences
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims : To develop students' analytical skills needed for applications in the areas of project management, industrial engineering and decision sciences so that they can utilize quantitative tools for the decision making processes in engineering practice.

Learning Outcomes: At the end of this course, students should be able to:

- Formulate Linear, Integer and Mixed Integer Programming problems and use methods such as Simplex and branch and bound for their solution.
- Use decision tables/ trees, and basic queueing models to make decisions under uncertainty, and risk.
- Formulate Dynamic Programming models for standard problems (Knapsack, Shortest path search) and solve them using the tableau method.
- Formulate multi criteria decision making problems using Data Envelopment Analysis; formulate and solve Analytic Hierarchy Problems (AHP) using matrix computations.
- Identify different non-conventional, evolutionary and heuristic algorithms such as Genetic Algorithm, Simulated Annealing and Ant Colony Optimization.
- Execute engineering projects as per project management lifecycle and use standard project management software for planning and management purposes.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		20
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Linear, Integer and Mixed Integer Programming Graphical solution method, Simplex method Sensitivity analysis Branch and Bound solution for Integer Programming problems	07	01		
2	Dynamic Programming: Dynamic Programming in mathematical optimization (Knapsack and Shortest Path Search) Applications of Dynamic Programming	04	01		
3	Decision Theory: Decision making under certainty, uncertainty, and risk	04	01		
4	Introduction to Project Management: Projects and non-projects, project life cycle concept, project manager's role Nine knowledge areas of project management Project planning and scheduling Project selection Statement of Work (SOW), Work-Breakdown-Structure (WBS) and Responsibility matrix Network analysis techniques: Critical Path Method (CPM), Project Evaluation and Review Technique (PERT) Gantt chart and resource mapping Monitoring and controlling project cost, quality, and time Investment appraisal of projects Computer applications for project management	08	01		02
5	Queueing Theory and Modeling: Single and multiple server, infinite and finite source models	04	01		

6	Introduction to Multi Criteria Decision Making: Introduction to Analytic Hierarchy Process (AHP) Data Envelopment Analysis (DEA)	07	01		
7	Introduction to Non-Conventional Optimization Techniques Evolutionary and heuristic algorithms	04			
	Total (hours)	38	06	0	02

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

Course Code	:	PR 410
Course Title	:	Manufacturing Engineering Project I
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims : To provide students the opportunity to carry out a project that is directly related to manufacturing engineering so that they can effectively formulate, plan, and solve real industrial problems.

Learning Outcomes: At the end of this course, students should be able to:

- Formulate a manufacturing engineering related problem that is relevant to the industry.
- Research relevant engineering literature for a given problem and critically analyze them.
- Set up experiments, develop analytical methods, models or prototypes, and/or use engineering software to test a given hypothesis/design.
- Plan and execute the said manufacturing engineering project in an organized manner.
- Effectively collaborate with team members and/or industrial partners to meet specific deadlines.
- Effectively communicate the details and outcomes of the project to a diverse audience through report writing and by making technical presentations.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Weekly progress evaluated by Supervisor		15
Interim Report/Proposal		15
Mid-Semester Presentation/Viva		20
End of Semester Evaluation	50	
Final Report		
Final Presentation/Viva		50

No	Topic	Time Allocation/ hours			
		L	**T**	**P**	**A**
1	Project planning, literature review, design and development of solution, report writing, presentation of findings, project demonstration	05			80
	Total (hours)	05	0	0	80

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

Semester 8

Course Code	Course Title	Category	Credit
PR409	Management Principles and Economics	Core	3
PR411	Manufacturing Engineering Project II to earn eligibility for Class Honours	Core	3

Course Code	:	PR 409
Course Title	:	Management Principles and Economics
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Core Course

Aims : To enable students to understand the basic principles of management, economics and professional ethics relevant to industrial practice so that they can work effectively as engineering managers in multidisciplinary environments.

Learning Outcomes: At the end of this course, students should be able to:

- Describe the different schools of management thought and explain their practical applications.
- Explain the basic strategic management concepts and provide organizational examples of successful strategic management.
- Explain how to effectively manage human resources and interact with persons of different psychological characteristics to achieve set goals.
- Describe and demonstrate the ethics needed for a professional engineer.
- Describe occupational health and safety measures in different industrial contexts, including the identification of common hazards at work.
- Define basic microeconomic and macroeconomic terms and interpret economic data.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Assignments		20
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Overview of Management Thought Introduction Basic functions of management Development of management theories Classical perspective, management science perspective Contemporary management theories (systems theory, contingency perspective, learning organizations)	06			02
2	Organizational Behaviour: Organizational structure, culture and systems Industrial psychology	05			02
3	Strategic Management Basics for Engineers: Introduction to strategy and strategic management Defining strategic intent Vision, mission, goals and objectives Corporate and business level strategies Organizational and environmental appraisal methods	04			02
4	Basic Human Resources Management for Engineers: Key functions of human resources management Recruitment and selections (Employment contracts) Developing effectiveness in human resources Training and career development Performance evaluation Enhancing employee-management relations Managing human resources in a multi-cultural environment Managing individuals for high performance Equal Employment Opportunity (EEO)	08			02
5	Occupational Health, Safety, and Professional Ethics	05			

6	Basic Economics for Engineers: Introduction to Microeconomics and Macroeconomics Basic concepts in Economics Demand, supply (theory of firm), producer surplus Product markets (theory of markets) Impact of unemployment, impact of inflation Economic policies Quota, taxes, tariff, price controls	12			02
	Total (hours)	40	0	0	10

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

Course Code	:	PR 411
Course Title	:	Manufacturing Engineering Project II
Credits	:	3
Prerequisites	:	PR
410 **Core/ Elective**	:	Core
Course		

Aims : To provide students the opportunity to carry out a project that is directly related to manufacturing engineering so that they can effectively formulate, plan, and solve real industrial problems.

Learning Outcomes: At the end of this course, students should be able to:

- Formulate a manufacturing engineering related problem that is relevant to the industry.
- Research relevant engineering literature for a given problem and critically analyze them.
- Set up experiments, develop analytical methods, models or prototypes, and/or use engineering software to test a given hypothesis/design.
- Plan and execute the said manufacturing engineering project in an organized manner.
- Effectively collaborate with team members and/or industrial partners to meet specific deadlines.
- Effectively communicate the details and outcomes of the project to a diverse audience through report writing and by making technical presentations.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Weekly progress evaluated by Supervisor		15
Interim Report/Proposal		15
Mid-Semester Presentation/Viva		20
End of Semester Evaluation	50	
Final Report		
Final Presentation/Viva		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Project planning, literature review, design and development of solution, report writing, presentation of findings, project demonstration	05			80
	Total (hours)	05	0	0	80

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

4.3. Technical Electives

PR 509 Plant Layout and Plant Management (3 credits)

PR510 Manufacturing Technology III (3 credits)

PR513 Modeling and Control of Mechatronic Systems (3 credits);
Prerequisite: *ME 306*

PR515 Financial and Management Accounting for Engineers (3 credits)

PR516 Sustainable Manufacturing (3 credits)

PR517 Lean Manufacturing (3 credits)

PR518 Performance Evaluation of Manufacturing Systems (3 credits);
Prerequisites: PR315

PR519 Robotics & Autonomous Systems (3 credits)
Prerequisites: ME306, PR513

PR521 Additive Manufacturing (3 Credits)

Course Code	:	PR 509
Course Title	:	Plant Layout and Plant Management
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective

Aims : To provide students with the knowledge, techniques and tools relevant to plant layout design and management so that they will be able to locate a plant, design the plant layout and manage the facility systems of a manufacturing plant.

Learning Outcomes: At the end of this course, students should be able to:

- Analyze the different strategies involved in plant location.
- Collect/extract data and information required for plant layout design.
- Apply mathematical tools and techniques to design and develop plant layouts and material handling systems.
- Identify key facility systems available in manufacturing plants and how to manage them effectively.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		20
Laboratory Work		10
Mid-Semester Examination		20
End of Semester Evaluation	50	
End of Semester Examination		50

No	**Topic**	**Time Allocation/ hours**			
		L	**T**	**P**	**A**
1	Introduction: Impact of plant location and layout on Supply Management	03			01

2	Plant Location Decisions: Factors affecting facility location Techniques to evaluate different facility locations	04	01		
3	Information Collection for Layout Design: Relationship of product, process schedule designs on layout design Space analysis Flow Analysis Activity relationships	03			01
4	Layout Design: Basic layout configurations Layout design and evaluations techniques Integration of material handling with layout design	08	01		02
5	Material Handling System Design: 8 R's of material handling 10 principles of material handling Different material handling designs Types of material handling equipment	08	01		02
6	Facility Systems: Structural and enclosure systems Atmospheric systems Electrical and lighting systems Life safety systems Sanitation systems Building automation systems Facility management systems	08	02		01
7	Industrial Case Study:	01			03
	Total (hours)	35	05	0	10

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR510 Manufacturing Technology III (3 credits)

Course Code	:	PR 510
Course Title	:	Manufacturing Technology III
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective Course

Aims : To enhance students' knowledge on computer integrated manufacturing systems and advanced manufacturing technologies so that they will be in a position to deal with the technological aspects in the manufacturing industry.

Learning Outcomes: At the end of this course, students should be able to:

- Interconnect several hardware modules with computers for realizing integrated operations.
- Design for manufacture with rubber and plastics and also for the use of non-conventional machining techniques, and for abrasive machining techniques.
- Analyze the effects of the input conditions causing dynamic instabilities and resulting problems in the products.
- Use dynamic measurements and their frequency spectrum for machine tool diagnostics.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		20
Laboratory Work		10
Mid-Semester Examination		20
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation / hours			
		L	T	P	A
1	Introduction: Computer Integrated Manufacturing Systems (CIMS) Computer aided Design/Engineering/Manufacturing and Process Planning (CAD/CAE/CAM/CAPP) Computer simulation of manufacturing processes and systems Cellular manufacturing, Flexible Manufacturing Systems (FMS), Just-in-Time (JIT) Production Communication Networks / AT	06	01	03	01
2	Non-traditional machining processes: ECM / EDM / Wire EDM / LASER BEAM Plasma Cutting/Welding Economics of nontraditional machining	06	01	03	01
3	Machining: Machining Process Monitoring Dynamometry / Machine Tool Dynamics	05	01	03	01
4	Design and Manufacture of Moulds: Plastics, rubber products Die casting	08	01	04	
5	Abrasive Machining and Finishing Operations: Grinding process Grinding operations / machines Design consideration Economics	05	01	03	01
	Total (hours)	30	05	16	04

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignments

PR513 Modeling and Control of Mechatronic Systems (3 credits); *Prerequisite*: ME 306

Course Code	:	PR 513
Course Title	:	Modeling and Control of Mechatronic Systems
Credits	:	3
Prerequisites	:	ME 306
Core/ Elective	:	Technical Elective

Aims : To enhance students' knowledge in model building, system identification, analysis of dynamic systems and control design techniques, especially in the discrete domain so that they will be able to model, design, analyze, and implement controllers in PC/ Microcontroller and verify their performance.

Learning Outcomes: At the end of this course, students should be able to:

- Model dynamic systems (using laws of physics and system identification techniques) and verify the same.
- Analyze dynamic systems in the discrete domain.
- Analyze behavior of systems and design of controllers in discrete domain.
- Verify controller performance through simulation, implementation and testing.
- Implement interfacing techniques of sensors, actuators and communication techniques between PC/Microcontroller and real world devices.
- Solve problems in the use of laws of physics or/and experimental methods in dealing with real world devices

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Computer controlled systems Mathematical modeling of systems, system identification Design of discrete time control systems Implementation of control algorithms	04			
2	s-domain and z-domain: z-transform, inverse techniques, Pulse Transfer Function, Equivalence between z-plane and s-plane, Root Locus, stability	07	02		01
3	Computer Controlled Systems: Sensors, actuators, interfaces, mathematical representation of these elements	05	01	03	
4	Modeling of Mechatronic Systems: Mathematical modeling of a DC Servo Motor driving a positioning system, model verification, experimental system identification of a single arm robot axis. Conversion between continuous time models and discrete time models	06	02	06	01
5	Design method for Discrete Time Controllers: Root Locus method, Direct design method, State Space method, Simulation with MATLAB	04	02		01
6	Implementation of Controllers: Interfacing and controller implementation in PCs, Microcontrollers and PLCs. Implementation of position and speed controller.	03	01	03	01
	Total (hours)	29	08	12	04

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR515 Financial and Management Accounting for Engineers (3 credits)

Course Code	:	PR 515
Course Title	:	Financial and Management Accounting for Engineers
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective

Aims : To introduce students to the main concepts in financial and management accounting to students so that they can interpret financial reports and effectively work as engineering managers.

Learning Outcomes: At the end of this course, students should be able to:

- Interpret profit and loss accounts and balance sheets of a company and calculate key performance ratios.
- Explain the key terms in financial accounting and describe the methods of accounting for adjustments such as depreciation, accruals, and bad debts.
- Calculate the net present value of investment options and make recommendations on suitable investments.
- Explain the different types of costs involved in management accounting and calculate the relevant costs attributable to a cost center.
- Use absorption and marginal costing to estimate the manufacturing cost of a product.
- Prepare sales and production budgets and calculate variances with the actual performance.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		20
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation / hours			
		L	T	P	A
1	Introduction to Financial Accounting: Purpose of financial accounting Key terms in financial accounting Trading profit and loss accounts Trial balance Adjustments for stock, depreciation, taxation, accruals etc. Balance sheet Manufacturing accounts Company accounts	16	01		
2	Financial Statements and Financial Reporting: Cash flow statement Annual reports Ratio analysis (profitability ratios, liquidity and gearing ratios) Limitations of ratio analysis	06			02
3	Valuation of Future Cash Flows: Time value of money (future value and compounding) Present value and discounting	02			
4	Capital Investment Decisions: Investment analysis Financial sources Risk and return Break-even analysis	06	01		02
5	Introduction to Management Accounting: Types of costs and cost centers Fixed/Variable/Marginal costs Full/Absorption/Marginal Costing Budgeting Actual versus planned variance	10	01		
	Total (hours)	40	03	-	04

Note: L - Lectures, T - Tutorials, P - Practical, A – Assignment

PR516 Sustainable Manufacturing (3 credits)

Course Code	:	PR 516
Course Title	:	Sustainable Manufacturing
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective

Aims : To introduce students to the concept of sustainability in product design, development, and manufacturing processes and to cultivate sustainability in the mindset of manufacturing engineers in order for them to use these concepts in their day to day decision making.

Learning Outcomes: At the end of this course, students should be able to:

- Explain the significance of sustainability in the modern world.
- Describe the challenges to sustainable manufacturing.
- Develop measurements for assessing sustainability in manufacturing.
- Adapt the eco-design concept in product design and development.
- Use green reporting scheme to present greening initiatives of manufacturing firms.

Assessment	Percentage Marks	
Continuous Assessments	50	
Assignments		20
Laboratory Work		10
Mid-Semester Examination		20
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation / hours			
		L	T	P	A
1	Introduction: Introduction to Sustainable Manufacturing The concept of sustainability and sustainable development Background to sustainable product design and processes Challenges to sustainable manufacturing Waste-free processes New material processes Enterprise modeling and simulation Improved design methodologies Education and training Significance of sustainable product design and manufacture	06			02
2	Sustainability as a Science: Need for sustainability science Applications to product design and manufacture	06			
3	Product Design for Sustainability: Measurements of product sustainability The impact of multi-life cycles and perpetual life products Product sustainability assessment Product sustainability index Environmental and societal impact Functionality, resource utilization Manufacturability, re-manufacturability and recyclability	12		03	
4	Processes and Measures for Sustainability: Processes for sustainability Selection of sustainability measures for manufacturing Energy consumption, manufacturing cost, Environmental impact, waste management Operational safety, personnel health	06		03	

5	Future directions of Sustainable Manufacturing:	08			
6	Case Study:				06
	Total (hours)	38	-	06	08

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR517 Lean Manufacturing (3 credits)

Course Code	:	PR 517
Course Title	:	Lean Manufacturing
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective Course

Aims : To introduce the main Lean Manufacturing concepts and to cultivate lean thinking in the mindset of manufacturing engineers in order for them to use these concepts in their day to day decision making.

Learning Outcomes: At the end of this course, students should be able to:

- Explain the significance of Lean concepts for manufacturing.
- Use Lean techniques for improving the performance of manufacturing industries.
- Identify the challenges and future directions of Lean Manufacturing.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials and Assignments		20
Laboratory Work		10
Mid-Semester Examination		20
End of Semester Evaluation	50	
End of Semester Examination		40

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction to Lean Manufacturing History of Lean manufacturing Evolution of Lean manufacturing concept House of Lean manufacturing Building blocks of Toyota Production System Seven types of wastes Difference between traditional and lean firm Value Stream Mapping	05	01		01
2	Foundations of Lean Thinking: Toyota-way philosophy Visual management Stable and standardized processes Level production	03			01
3	Lean Manufacturing Techniques: Production smoothing concepts Just in Time Production (JIT), Kanban systems Single piece flow concept Single Minute Exchange of Dies (SMED) Process visualization	09	02	03	01
4	Quality Conscious Manufacturing: In-station quality Autonomous defect control Total Quality Management (TQM) concept Continuous process improvement Lean 6 Sigma concept	06	01		01
5	Total Productive Maintenance: Basic steps of TPM Pillars of TPM Different indices of TPM	06	01		01

6	Human Factor in Lean Manufacturing: Lean leadership Sustainability Cultural and sociological aspects of Lean implementation	03			01
7	Extensions of Lean Manufacturing and Future Challenges: Agile manufacturing Smart manufacturing	03			01
	Total (hours)	35	05	03	07

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR518 Performance Evaluation of Manufacturing Systems (3 credits);
Prerequisites: PR315

Course Code	:	PR 518
Course Title	:	Performance Evaluation of Manufacturing Systems
Credits	:	3
Prerequisites	:	PR 315
Core/ Elective	:	Technical Elective Course

Aims : To give students the knowledge and understanding of analytical and simulation methods used to measure/evaluate manufacturing system performance so that they can select appropriate methods to analyse real manufacturing systems.

Learning Outcomes: At the end of this course, students should be able to:

- Describe commonly used performance metrics of manufacturing systems and explain how they are measured/calculated.
- Construct computer simulation models of manufacturing systems, evaluate their performance, and interpret the results.
- Develop continuous time Markov chain models of small manufacturing systems and evaluate their steady state performance.
- Use approximate methods to calculate the performance measures of larger manufacturing systems.
- Develop queueing models of manufacturing systems and compute the average performance estimates using mean value analysis.
- Compare and contrast the analytical and computer simulation methods of evaluating manufacturing system performance.

Assessment	**Percentage Marks**	
Continuous Assessments	40	
Tutorials and Assignments		30
Laboratory Work		10
End of Semester Evaluation	60	
End of Semester Examination		60

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Performance evaluation of manufacturing systems Performance measures – definitions and relationships	04			03
2	Simulation of Manufacturing Systems: Manufacturing systems modeling Generation of random variates Simulation procedure Analysis of simulation input/output data Case studies	11	01	03	08
3	Markov Chain Models of Manufacturing Systems: Discrete Time Markov Chain (DTMC) models of small manufacturing systems Continuous Time Markov Chain (CTMC) models of small manufacturing systems Approximate methods for modeling larger manufacturing systems	12	01		04
4	Queueing Models of Manufacturing Systems: Single server models Open networks, Closed networks Mean value analysis	06	01		
	Total (hours)	33	03	03	15

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR519 Robotics & Autonomous Systems (3 credits) *Prerequisites:* ME306, PR513

Course Code	:	PR 519
Course Title	:	Robotics and Autonomous Systems
Credits	:	3
Prerequisites	:	ME 306, PR 513
Core/ Elective	:	Technical Elective Course

Aims : To enhance students' knowledge on the structure, assembly, kinematics, dynamics and control of robots and autonomous systems so that they will be able to learn and practice implementing algorithms/controllers and programming robots.

Learning Outcomes: At the end of this course, students should be able to:

- Demonstrate knowledge on the structure, mechanism, design and analysis of robotic systems and their programming and control strategies.
- Solve problems on robot dynamics, kinematic and dynamic simulations and controller design and implementations.
- Design and analysis of mechanisms used in robotic applications.
- Analyze behavior of robotic systems and design of controllers in achieving position/velocity control.
- Implement interfacing techniques of sensors and actuators, used in robotics and autonomous systems.
- Be confident in the design, assembly and control of robotic devices and also in robot programming.

Assessment	**Percentage Marks**	
Continuous Assessments	50	
Tutorials		10
Laboratory Work		10
Mid-Semester Examination		30
End of Semester Evaluation	50	
End of Semester Examination		50

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction to Robotics and Autonomous Systems: Basic concepts in robotics, classification and structure, sensors and actuators in robotic systems, autonomous systems.	04		04	
2	Manipulator Kinematics: Link description, Mechanisms and design Joint space and Cartesian space, Kinematic Analysis and Coordinate Transformations, Jacobian: Velocities and forces	07	01	02	
3	Manipulator Dynamics: Acceleration of a rigid body, Mass distribution, Newton's equation, Euler's equation, Structure of Manipulator dynamic equation	05	01		
4	Trajectory Planning: Joint space and Cartesian space, Cubic polynomials, Path generation, via points and parabolic blends	03		02	
5	Autonomous Mobile Robots: Locomotion and kinematics, open loop and closed loop control, trajectory following, perception and localization	07	01	04	
6	Manipulator Control: Feedback and Closed-loop control, Control law partitioning, Trajectory following control, Modeling and control of a single joint, Industrial robot controllers.	07	01	04	
	Total (hours)	33	04	16	0

Note: L - Lectures, T - Tutorials, P - Practical, A - Assignments

PR521 Additive Manufacturing (3 Credits)

Course Code	:	PR 521
Course Title	:	Additive Manufacturing
Credits	:	3
Prerequisites	:	None
Core/ Elective	:	Technical Elective Course

Aims : To improve the knowledge and skills of students in Additive Manufacturing technology and related topics so that they will be able to select appropriate technologies and materials and adopt proper design methods for creating models and manufacturing components using additive manufacturing.

Learning Outcomes : At the end of this course, students should be able to:

- Explain the main Additive Manufacturing (AM) processes/ methods used in industry and research.
- Demonstrate comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials that are available.
- Identify and select most appropriate AM process/ material to manufacture a given product.
- Design objects by using Design for AM principles.
- Manufacture physical objects that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.

Assessment	**Percentage Marks**	
Continuous Assessments	40	
Assignments		20
Laboratory Work		20
End of Semester Evaluation	60	
End of Semester Examination		60

No	Topic	Time Allocation/ hours			
		L	T	P	A
1	Introduction: Milestones in Additive Manufacturing (AM) development Basic principles of AM Benefits of AM Classification of AM Processes Applications of AM (Aerospace, Manufacturing, etc.)	04			
2	Generalized Additive Manufacturing Process Chain The eight steps in additive manufacture	02			
3	Additive Manufacturing Technology: Photopolymerization processes Powder bed fusion processes Extrusion-based systems Material/Binder Jetting Sheet lamination processes, Beam deposition processes Direct write technologies	15		06	03
4	Design for AM: Unique capabilities Design tools Exploring design freedoms Guidelines for process selection Selection of materials and processes	05		03	03
5	Software Issues in AM: STL file format and preparation File manipulation Handling multiple colors and materials	02		03	

6	Other Related Technologies: Mould-making, Casting 3D scanning Reverse engineering Rapid tooling	04		03	03
7	Trends and Future Directions:	01			
	Total = 33+0.5*(15+09) = 45	33		15	09

Note: L - Lectures, T - Tutorials, P - Practicals, A - Assignments

4.4. Industrial Training

Course Code	TR400
Course Title	Industrial Training
No. of Credits	6
Pre-requisites	Successful completion of the General Programme in Engineering
Compulsory/Optional	Compulsory
Aim(s): To provide an industrial exposure for the students to gain knowledge, professional skills and experience through understanding industrial operations, application of theoretical knowledge in real working environment and work ethics.	
Intended Learning Outcomes: On successful completion of the course, the students should be able to; ILO1: Describe the organization and its Management, Operational procedures and Quality assurance and standards. ILO2: Describe how Engineering Principles are applied in real situations with practical issues and possible solutions in such applications. ILO3: Explain ethical practices, professionalism, health and safety, social aspects and sustainability practices in industrial/ research environments. ILO4: Present training experience to a technical audience	
Time Allocation:Lectures:15 hours Practical: 800 hours (20 weeks) field work	

Assessment	**Percentage Marks**
In-course	
Presentations	10
End-Course	
Training Diary	30
Training Report	30
Oral Examination (Viva)	30

Course Content	Time Allocated			
	L (hours)	T (hours)	P (hours)	A (hours)
Introduction to Industrial Training course Aims and Intended Learning outcomes of the course, importance of industrial training for engineering undergraduates	1			
Introduction to Industrial Training Programme Overview of the industrial training programme, parties involved and their responsibilities, schedules of training programme, procedures of arrangement of training, reporting for training and documentary work, behavior during the training period	1			
Guidelines for demonstration of the knowledge and experience gained through training Maintenance of daily diary, report writing, effective presentations	2			
Industrial Health and Safety Practices	2			
Quality Assurance and Standards	1			
Professional Conduct and Ethics	1			
Career Development Skills Self-motivation, Critical thinking, Social etiquettes, CV Writing, Interview facing	7			
Industry exposure through training in industrial/ research organizations Understanding the organization and its operational procedures, application of engineering			800 (20 weeks)	

fundamentals, issues and possible actions, quality assurance practices, health and safety practices, ethical practices, social and sustainability practices, effective communication				
Total	15		800 (20 weeks)	

5. Other Useful Information

5.1. Getting Help and Advice

Student Guide to Registration and Course Completion

The students should conform to the Rules and Regulations of the Undergraduate Programme of the Faculty of Engineering given in Annexure I. Any clarification on the contents therein may be sought from the Dean or Assistant Registrar of the Faculty. Following section provide answers only to frequently asked questions.

a) The course selection may be changed during ADD/DROP period, after which no changes in registration are possible. The students who were unable to drop a course during the ADD/DROP period should follow the whole course and the grade will appear in the Academic Transcript.

b) After the ADD/DROP period the total recommended work load from the registered courses for the Semester is 18 credits and should not exceed 24 credits. The credits from TR400: Industrial Training Course which is normally conducted during the vacation is outside this limit.

c) The students who fail to satisfactorily follow the course will get a grade E for the particular course. Note: Students who have failed to satisfy 80% attendance requirement of a course are considered to have not satisfactorily followed the course.

d) Normally a grade of C is required to earn credit in any course. If the grade is poor (less than C) the course can be repeated in a subsequent semester provided that the timetable allows to fulfil the attendance requirement. However, the maximum grade awarded for a repeated course unit is a "C".

e) Only those who have a potential to Complete or Provisionally Complete the General Programme by registering to a maximum of 3 courses and obtaining credits from them are allowed to register for the Special Session of the General Programme. In order to be eligible to register to a course in Special Session of the General Programme, a student should have followed it satisfactorily in the Semester 1 or 2 of the same academic year.

f) Specified number of credits should be obtained from the general elective courses recommended by your Department. Also, a minimum of 02 credits should be earned from the courses of each of the three categories; Management & Economics, Arts & Humanities and Political & Social Sciences

g) Following a new elective course, the students have a chance of earning a grade as high as A+. Therefore, repeating an elective course which gives a maximum grade of C may not be productive.

h) Students can follow more technical/general elective courses than the minimum number required for successful completion of the degree. All the credits and grades of courses including repeated courses followed by a student will be shown in the academic transcript. However, a student can select the elective courses in

which he/she has obtained the best grades to satisfy the GPA and credit requirements for the degree subject to the approval of the relevant Department.

i) The sum of the credits of the selected electives (both technical and general separately) may sometimes exceed the minimum requirement by 1 credit due to different credit values from 1 to 3. This is allowed.

j) The student can graduate with Class Honours if he/she completes the minimum graduation requirements within three years of entering the Specialization Programme in Engineering. Any student who has failed to complete the minimum graduate requirements within three years of entering the specialization programme in Engineering is not eligible to get Class Honours unless if he/she has been granted special permission.

k) The student should apply for graduation and demonstrate the completion of all requirements for graduation by filling the Degree Claim Form (DCF).

l) If a student falls ill while in residence, he/she should immediately get in touch with the Chief Medical Officer of the University Health Centre. If the student falls ill at home or elsewhere during sessions or examination time, his/her guardian should inform the Dean of the Faculty by a letter within one week stating the nature of illness, the name of the attending doctor etc.

m) If a student fails to attend an examination of a registered course due to illness or other exceptional reason and if he/she wishes to request for a makeup examination, he/she should make a request from the Dean of the Faculty for a makeup examination by a letter by the student himself or by a third person within one week of the examination of his/her absence with the valid reason for absence for consideration.

n) To be excused for absence from examinations, coursework etc. for medical reasons, the student should submit to the Dean of the Faculty a valid Medical Certificate conforming to the format of a medical certificate issued by a Government Hospital.

o) The medical certificate should be obtained from the Chief Medical Officer of the University or a District Medical Officer or, where treatment from a specialist is necessary, from a consultant specialist in the relevant field, or the Head of a Government Base Hospital, or the Medical Superintendent of a Provincial Ayurvedic Government Hospital. Under exceptional circumstances, the University Medical Board may accept medical certificates issued by a private hospital or by a registered private medical practitioner.

p) A student seeking to get his/her registration deferred at the time of registration should inform the University, giving reasons for such deferment, and obtain permission from the University for such deferment.

q) If a registered student is compelled to discontinue his/her course of study for any reason, he/she should notify the Dean of the Faculty as soon as possible to obtain permission to be away from the University. If a registered student of the

University has abandoned his/her course of study without notifying the Dean, his/her request for readmission will not be entertained.

r) A request for absence, where granted, is for a maximum of one academic year, except on approved medical grounds. A request granted on medical grounds is for a maximum of two academic years. Readmission of the student is subject to the availability of a place in the Faculty at the time of re-admission. If a student fails to have his/her registration renewed at the beginning of each academic year as required, his or her name will be deleted from the class list of the Faculty, and the student will be informed accordingly.

Financial Assistance and Awards

Financial assistance is normally provided to needy Sri Lankan undergraduates in the form of Mahapola Scholarships and other awards by individuals and organizations.

Mahapola Scholarships

This is a national scheme introduced by the Government of Sri Lanka to financially support deserving Sri Lankan students in institutions of higher education. The Mahapola Scholarship Trust Fund set up for this purpose offers two categories of Scholarships:

Mahapola Higher Education Merit Scholarships awarded on the basis of merit.

Mahapola Higher Education Scholarships awarded to needy students in the form of bursaries.

The general conditions on which these scholarships are awarded are:

(a) Scholarship moneys are payable for only ten-months of the academic year.

(b) A student receiving a Mahapola Scholarship cannot benefit financially from any other scholarship, but the student has the option to choose the scholarship from which he/she may receive financial support.

(c) The Board of Trustees may withdraw the scholarship awarded to a student if his/her work, conduct or attendance is reported to be unsatisfactory by the University Grants Commission or if the student fails an examination at the first attempt.

Endowed Academic Awards

The following awards are available to students of the Faculty of Engineering While merit is the sole criterion for the award of Medals, Prizes and Scholarships, financial need is an important consideration in the award of Studentships The criteria to select the best suitable student for each award and studentship may be revised to suit the course unit system and the changes in syllabi

Medals

The EOE Pereira Gold Medal endowed by friends and well-wishers of Professor EOE Pereira and awarded to the most outstanding student graduating from the Faculty.

Prizes for Overall Performance

- The Ananda Amarasinghe Memorial Prize endowed by Messrs B Amarasinghe and AJ Edwards and awarded for the student obtaining the highest GPA at the end of second semester.
- The Sri Lanka Tyre Corporation Prizes awarded on the performance at the First & Second year Examinations to Second and Third Year students who are children of employees of the Sri Lanka Tyre Corporation.
- The Ranjan Herath Gunaratne Prize endowed by students of the Faculty and awarded for the student who has obtained the highest GPA in the examinations held during third and fourth semesters in the BSc Engineering Programme.
- The EOE Pereira Prize endowed by friends and well-wishers of Professor EOE Pereira and awarded for the student who has obtained the highest GPA in the examinations held during fifth and sixth Semesters in the BSc Engineering Programme.
- The CA Hewavitharana Memorial Prize in Engineering endowed by Mr. W.D. Hewavitharana and awarded for the student obtaining the highest GPA in the examinations held during seventh and eighth semesters in the BSc Engineering Programme.
- The Colombo Dockyard Prize for Production Engineering, endowed by Colombo Dockyard Ltd. and awarded to the student with the highest GPA obtained in the Specialization Programme of BSc Engineering in the branch of Production Engineering.

Prizes for Performance in a Subject

- The T Sivaprakasapillai Prize for Industrial Engineering endowed to the Engineering Alumni Awards Fund by Mr. J.B. Dissanayake and awarded to the student with the highest average GPA obtained for the two courses PR408 and PR409.
- The JB Dissanayake Prize for Industrial Training endowed to the Engineering Alumni Awards Fund by Professor A.S. Balasubramaniam and awarded to the student with the highest Grade in the course TR400.
- The EF Bartholomeusz Prize for Engineering Mathematics endowed to the Engineering Alumni Awards Fund by Mr. K.K. Gunawardana and awarded to the student with the highest GPA in Mathematics courses.
- The M. Amaratunga Prize for Strength of Materials endowed to the Engineering Alumni Awards Fund by Professor M.P. Ranaweera and awarded for the student with the highest Grade in CE201.
- Samantha Kularatne prize for best performance in the first semester of the General Programme in Engineering.

5.2. University Life

University experience extends beyond classrooms, labs and studios. It encompasses residence halls and dining halls, clubs and sports, fraternities and sororities, campus events and performances, and countless off-campus destinations. University of Peradeniya touts 50-plus student organizations, dozens of prestigious living and learning communities, and countless other ways to get involved. Students here can create a unique identity and grow as individuals, even as they're part of a close-knit and diverse community.

As this is a full-time study programme, students are free to stay in the university involving different activities which can support enhancing the quality of students' life as well as contributing the society needs. Some of the societies that students can involve are listed below.

MEA-Manufacturing Engineering Association

Manufacturing Engineering Association is the student wing of Manufacturing and Industrial Engineering department. The society consists of all the students of the second year, third year and final year, who are following the manufacturing and engineering field. Currently the society is renowned as one of the most active student societies of Faculty of Engineering. The main goal is to ensure the perfection of the students that follow this course. Under the scope, MEA is committed to develop the technical, academic and soft skills. Office bearers are selected from both the students and the academic staff as well. As the current MEA structure, The President, The Secretary and The Treasurer are selected from the academic staff while Junior President, Junior Vice President, Junior Secretary, Junior Vice Secretary and the Junior

Treasurer are selected from the students. There are five committee members are selected, one from the final year students, and two from each second and third year students. For the sub committees also several students are selected.

PEFAA- Peradeniya Engineering Faculty Alumni Association

The Peradeniya Engineering Faculty Alumni Association (PEFAA), formed in September 1991, is a government registered charity organization. Its main objectives are to encourage, foster, and promote close relations between the Faculty and its alumni and among alumni, and also to assist and support, financially and otherwise, the Faculty and its students and alumni. Any person who has completed an undergraduate or postgraduate course in the Faculty or has been a member of the academic staff of the Faculty can be a Life Member of PEFAA. Here 'Faculty' means the Engineering Faculties of the University of Ceylon, the University of Sri Lanka (Peradeniya Campus), and the University of Peradeniya. The present membership is around 4500. PEFAA supports needy students of the Faculty by giving financial assistance through its Needy Students' Fund, and its Benevolent Fund helps needy alumni. It also helps the undergraduates through orientation programs and by organizing lectures and seminars on industry related topics. PEFAA also supports industrial training of undergraduates and collects material for the Faculty library and laboratories through its members. In the recent past, PEFAA has been involved in administering a number of scholarships to undergraduates, granted by alumni.

In addition to the Annual General Meeting, PEFAA organizes trips, visits and get-togethers for its members to meet and exchange ideas both formally and informally. A quarterly newsletter (PEFAA News) keeps members informed of PEFAA activities.

In 1997 PEFAA embarked on its most ambitious project, setting up of the Engineering and Technology Centre (ET Centre). The main objective of the ET Centre is to educate, entertain and inspire people of different backgrounds by making Engineering and Technology accessible to them at their own level. The location for the proposed ET Centre is directly opposite the Faculty, across the Upper Gampola Road. The estimated cost of the project is about Rs. 120 million. Due to lack of sufficient funds this project was abandoned.

At the last AGM it was decided to use the collected funds of ET center for PEFAA activities. If any donor has any concerns they were requested to inform the secretary PEFAA before 31 March 2018. Since there were no objections, the Ex-Co decided to open a Fixed Deposit whose interest (75%) will be used for the PEFFA activities. Remaining 25% will be capitalized

ESU- Engineering Students' Union

"Arunella" is the highest and best activities among all of the activities organized by ESU. This helps O/L students conducting seminars and supporting the best performing students with scholarships. Also, ESU organizes annual construction of a building for a selected poor school annually. The society also helps low-income students with financial supports.

Rotaract

Any student has the freedom in joining this society. It organizes some students soft-skill development activities and develops team building, also it helps needy people annually in natural disasters.

Aisec

Main aim of Aisec is to develop leadership skills of students. Further they organize internships and students exchange progrqammes for the self-development of the members and non-members as well. Aisec helps students to cope with the cooperate world in a professional perspective.

Gavel club

This society supports student to develop and enhance their presentations skills, linguistic skills. They organize different activities to highlight personality of students.

Other student societies

Explores Club
Robotics Club
Innovators Club
Art Circle
SEDS
Guage
Vibhawa
EWBSL- Engineers Without Borders-Sri Lanka
Entrepreneurs Club

5.3. Life-Long Learning Opportunities with MIE

The Department of Manufacturing and Industrial Engineering offers two Postgraduate Programmes (PG) in Engineering Management, which was commenced in year 2001 and Manufacturing Engineering.

Postgraduate Programme in Engineering Management.

This programme has designed to enhance the knowledge and skills required for graduate engineers to successfully manage engineering operations and projects, work in multidisciplinary teams and advance their careers to strategic management levels in Engineering Organizations.

Those who are interested in Postgraduate degrees offered by those areas can get more details from Centre for Engineering Research and Postgraduate Studies – CERPS http://eng.pdn.ac.lk/cerps

Postgraduate Programme in Manufacturing Engineering

This programme has designed to enhance the knowledge and skills required for graduate engineers to successfully apply the engineering knowledge based on manufacturing to a range of manufacturing engineering environments and also work with multidisciplinary teams. Due to the dynamic nature of global and local industrial environments and to cater to the high expectations of graduate engineers, the programme has designed in a way that participants to have the opportunity to study at state of the art manufacturing facilities and also visit selected industrial locations.

The programme outlines,

- Computer Integrated Manufacturing
- Materials and Processes in Manufacturing
- CAD/CAM/CAE
- Product Design for Manufacture and Assembly
- Operations Management
- Quality Planning and Management
- Manufacturing Automation and Robotics
- Machine Tool Engineering
- Sustainable Manufacturing
- Mechatronic Systems for Manufacturing
- Simulation of Manufacturing Systems
- Technology Management and Innovation

Manufacturing & Industrial Engineering

Department of
Manufacturing & Industrial Engineering

Faculty of Engineering
University of Peradeniya