Semester VII									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme for (L T P)**			
						Component	**Exam**	**WT**	**Pass %**
MET-2701	Industrial Hydraulics and Pneumatics	2	-	-	2	Theory (50)	FET	20	Min 40
							CAT	30	
							ESE	50	Min 40
MET-2702	Refrigeration and Air Conditioning	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2703	Automatic Control System	2	-	-	2	Theory (50)	FET	20	Min 40
							CAT	30	
							ESE	50	Min 40
MET-2704	Program Elective III	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2705	Program Elective IV	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2706	Refrigeration and Air Conditioning Lab	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2707	Industrial Hydraulics and Pneumatics lab	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2708	Computer Programming lab	-	-	2	1	Practical (100)	FEP	50	Min 40
MET-2709	Software proficiency- III	-	-	4	2	Practical (100)	FEP	100	Min 40
MET-2710	Program Elective III Lab	-	-	2	1	Practical (100)	FEP	100	Min 40
Tracks Phase I									
II2701	Industry Internship Program (IIP-II) with project	-	-	2	1	Project	FEP	100	Min 50
ED2701	Entrepreneurship Venture Scheme (EVS)	-	-	2	1	Project	FEP	100	Min 50
RE2701	Undergraduate Research Opportunity Program (UROP)	-	-	2	1	Project	FEP	100	Min 50

CP2701	Capstone Project with Vertical and University Open Electives	-	-	2	1	Project	FEP	100	Min 50
Total		**13**	**-**	**14**	**20**	**Total Hrs: 27, Total Credits: 20**			

Program Elective III

Design & Analysis	MET-2704.1	Mechanical Vibration
Manufacturing Technology & Management	MET-2704.2	Supply Chain Management
HVAC	MET-2704.3	Thermal System Design
Automotive Technology	MET-2704.4	Automotive System Design

Program Elective III Lab

Design & Analysis	MET 2710.1	Mechanical Vibration Lab
Manufacturing Technology & Management	MET 2710.2	Supply Chain Management Lab
HVAC	MET 2710.3	Thermal System Design Lab
Automotive Technology	MET 2710.4	Automotive System Design Lab

Program Elective IV

Design & Analysis	MET-2705.1	Design of Mechanical Systems
Manufacturing Technology & Management	MET-2705.2	Industrial Engineering & Management
HVAC	MET-2705.3	Cryogenics
Automotive Technology	MET-2705.4	Electric Vehicles

Final Year (Semester – VII)

MET 2701	Industrial Hydraulics and Pneumatics	L	P	C
		02	-	02

Course Description

It includes introduction to hydraulic and pneumatic systems. Basic components. symbols - hydraulic valves , hydraulic pumps/motors/actuators, development of hydraulic circuit, regenerative and similar circuits, , pneumatic valves, pneumatic actuators, pneumatic circuits & systems, fluid logic, application of hydraulics & pneumatics in industrial automation, maintenance and troubleshooting of hydraulic & pneumatic systems.

Pre-requisites

Fluid Mechanics MET208

Course Objectives

1 Identify the components from symbols
2 Read the Hydraulic circuits
3 Recommend suitable circuits for specific applications

Course Outcomes Bloom'sLevel

Students will be able to

CO 2701.1	**Explain**[2] basic principles of hydraulics and pneumatics	02
CO 2701.2	**Elaborate**[2] the different elements of hydraulic and pneumatic system	02
CO 2701.3	**Develop**[3] hydraulic and pneumatic circuits for different applications	03
CO 2701.4	**nterpret**[2] safety regulations and troubleshooting in hydraulic and pneumatic system applications	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution		30%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100		

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2701.1	2											2		
CO 2701.2	2									2		2		
CO 2701.3	2	2	3							2		2		2
CO 2701.4	2	2								2		2		
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2701	Industrial Hydraulics and Pneumatics	
	Course Content	Hrs
Unit 01	**Introduction to fluid Power.** a. Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, effect of temperature on fluids. b. Introduction and Application of pneumatics, Physical properties, Principles, basic requirement of pneumatic system, comparison with hydraulic system.	06
Unit 02	**Hydraulic System Elements:** a. Types of hydraulic motors, Types of Actuators and Accumulators, Types of seals, sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control, strainer, filter, heat-exchanger, reservoir. b. Principle and types of Pressure control valves, Principle and types of direction Control valves, Principle and types of flow control valves. **Pneumatic System Elements:** Air compressors, Different valves used, Pneumatic actuators, Serving of compressed air – types of filters, regulators, lubricators (FRL unit), mufflers, dryers etc.	08
Unit 03	**Hydraulic Circuits and its Application** i. Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach and slow traverse. ii. Sequence circuits – Travel dependent and Pressure dependent iii. Synchronizing circuit. iv. Regenerative circuit. **b) Pneumatic Circuits and its Application** i. Speed control circuits ii. Impulse operation circuit. iii. Sequence circuits. iv. Time delay circuit.	08
Unit 04	a) Hydraulic and Pneumatic servo system for linear and rotary motion. b) Maintenance, troubleshooting and safety of hydraulic and pneumatic systems. c) Introduction to fluidics – study of simple logic gates, turbulence, amplifiers. Pneumatic Sensors, applications.	06

Reference Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Oil hydraulics Systems	S. R. Mujumdar	Tata McGraw Hill	2nd Edition
02	Industrial Hydraulic	J. J. Pipenger	Tata McGraw Hill.	2nd Edition
03	Pneumatic Control	Joji P.	Wiley Publication	1st Edition
04	Introduction to Hydraulic and Pneumatics	S. Ilango and V Soundararajan	Prentice Hall of India	2nd Edition
05	Industrial Fluid Power	S.S. Kuber	NiraliPrakashan	3rd Edition
06	Hydraulics and Pneumatics	Shaikh and Khan	R.K. Publication.	2nd Edition

MET 2702	Refrigeration and Air Conditioning	03	--	03

Course Description

The course consists of different refrigeration cycles and understanding of psychrometry and psychrometric processes used for the purpose of air-conditioning. Further, the comfort air-conditioning and indoor environment health are also discussed in this course.

Pre-requisites

MET-207 Thermodynamics, MET-307 Heat and mass transfer

Course Objectives

1 Learning the fundamental principles and different methods of refrigeration and air conditioning.
2 Comparative study of different refrigerants with respect to properties, applications and environmental issues.
3 Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 2702.1	Explain the need and importance of HVAC technology,	02
CO 2702.2	Evaluate vapor compression system	03
CO 2702.3	Illustrate various refrigerants and contemporary issues of ozone depletion and global warming potential with respect to refrigeration systems.	02
CO 2702.4	Apply psychrometry and thermal comfort conditions with respect to temperature and humidity and human clothing and activities and its impact on human comfort, productivity, and health.	03
CO 2702.5	Analyze heat transfer in buildings and heating and cooling load estimation	04

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%		
Passing	40%			40%		
Planned Marks	30	30	100	100		

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2702.1	2													
CO 2702.2	3													
CO 2702.3		2								3				
CO 2702.4	3	2	3											2
CO 2702.5	2	2	3							3				2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2702	Refrigeration and Air Conditioning	
	Course Content	Hrs
Unit 01	**Application of Second Law of Thermodynamics** A Refrigerating Machine – The Second Law Interpretation, Energy Ratios (EER), BEE star rating COP, Power Consumption of a Refrigerating Machine, Refrigerat ion Cycle, vapour as a Refrigerant in Reversed Carnot Cycle Limitations of Carnot Cycle with Gas as a Refrigerant, Reversed Brayton or Joule or Bell Coleman Cycle, Introduction to aero -plane air conditioning cycles (Only Theory)	06
Unit 02	**Vapour Compression System** Limitations of Reversed Carnot Cycle with Vapour as a Refrigerant, Dry versus Wet Compression, Throttling versus Isentropic Expansion, Vapour Compression Cycle, Pressure Enthalpy Diagram and Calculations and effect of Operating Conditions, effect of Evaporator Pressure Effect of Condenser Pressure, effect of Suction Vapour Superheat, effect of Liquid Sub-cooling, Using Liquid- Vapour Regenerative Heat Exchanger, Actual Vapour Compression Cycle. Removal of flash gas, Flash inter-cooling, Multistage, Multi evaporator and cascade system, Choice of Intermediate Pressure, System Practices for Multistage Systems (Simple analytical treatment), Introduction to cryogenic Engineering and applications, Claude Cycle, Linde Cycle.	07
Unit 03	**Refrigerants and Refrigeration Equipment** Classification, Desirable Properties like Thermodynamic, physical, and chemical. Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerants. Environmental Protection protocol and India's commitment. ASHRAE nomenclature. Insulation, types and different applications, different types of compressors, Condenser, Evaporator, Expansion devices, Types, selection. Component balancing, safety devices and refrigeration controls. Applications of Refrigeration, Ice plant, Cold storage, Dairy plant.	07
Unit 04	**Psychrometry and Human Comfort** Moist air as a working substance, Psychometric properties of air, Use of Psychometric tables and charts, Processes, Combinations and Calculations, ADP, Coil Condition lime, Sensible heat factor, Bypass factor, Air washer and it's applications. Chillers, types and applications.	07
Unit 05	**Heating and Cooling loading calculations** Design of air conditioning systems, different Heat sources, - Adiabatic mixing of two airstreams, sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point, Ventilation and infiltration, Inside and Outside Design condition. Cooling Load estimation, Introduction to Unitary Products viz. Room/Split and Packaged Air Conditioners, Central air conditioning systems, Variable Refrigerant Flow systems, VAV control systems, Inverter Units.	07
Unit 06	**Air Distribution System** Re-circulated air, Ventilation air, Duct work, Use of friction loss and rectangular equivalent of round duct chart, duct system, principle of duct sizing, and air distribution it's norms, diffusers, dampers, layout, duct systems for theatres, auditorium, hospitals, assembly shop etc., Energy Conservations and Green Buildings, Freeze drying, Pharmaceutical and hospital air conditioning, textile, car air conditioning (plant layout, system components and design conditioning)	06

Reference Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Refrigeration and Air Conditioning	C. P. Arora	Tata McGraw Hill	1981,2nd Edition
02	Basic Refrigeration And Air Conditioning	P N Ananthanarayan	Tata McGraw Hill	3rd Edition, (1981)
03	Principles of Refrigeration	Roy J. Dossat	Pearson Education	4th Edition
04	Refrigeration and Air Conditioning	Stoker		
05	Refrigeration and Air Conditioning	Arora Domkundwar	Pearson Education	3rd Edition.

Final Year (Semester – VII)

MET 2703	**Automatic Control Systems**	**02**	**--**	**02**

Course Description

This is a multidisciplinary course with applications across a wide range of industrial sectors. It gives a sound fundamental understanding of the principles underlying the operation of control systems and mechatronics which enable students to apply modern control principles in various areas of industry.

Pre-requisites

FYT 107 - Elements of Electrical Engineering, MET201 - Differential Calculus & Transforms

Course Objectives

To understand concepts of the mathematical modeling, feedback control, linearization, of nonlinear system, stability of system and modern mechatronics tools

	Course Outcomes *Students will be able to*	Bloom's Level
CO 2703.1	**Develop** analogy using F-I and F-E and classify Control Systems.	3
CO 2703.2	**Make use of** block diagram rules to develop the control systems and **Explain** Linearization of nonlinear functions	3
CO 2703.3	**Analyze** Stability of Control System and draw root locus.	3
CO 2703.4	**Construct** PLC Program by using timers, counters.	2

Evaluation Strategy

Component	CAT	FET	ESE	FEP
% Contribution	30%	20%	50%	--
Passing	40%	40%	40%	--
Planned Marks	30	20	50	

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2703.1	3				3		2						1	
CO 2703.2	3				3		2						1	
CO 2703.3		2			3		2						1	
CO 2703.4	3				3		2						1	
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2703 **Automatic Control Systems**

Course Content Hrs

Unit 01 **Basics of Control Systems**:
Background, definitions, classification of control systems.
Mathematical Model of Control System:
Concept of transfer function, mechanical translational/ rotational systems, electrical systems, equivalent mechanical system, grounded chair representation, analogous systems - Force Voltage and Force Current analog, 08

Unit 02 **Representation of control system**:
Linearization of nonlinear functions, Linearization of operating curves.
Block Diagram Representation of Control System: Components Block diagrams, block diagram algebra, rules for reduction of block diagram 06

Unit 03 **Stability & Root Locus Technique**:
Concept of poles and zeros, distinct, repeated and complex poles. Routh's Stability Criteria, Special case for stability, Range for K. Significance of Root Locus, Construction of Root Loci, General Procedure, Root locus for simple poles and zeros. 08

Unit 04 Introduction to **PLC & SCADA Systems**, PLC LAD programming, Communication Protocol (RS232, RS485, Modbus TCP/IP), Introduction to Sensors Technology, Image Processing & Machine vision, basics of Ardino based microprocessor – Raspberry PI, Introduction to IoT, MQTT – AWS, working of Touch screen sensor technology, Types of displays - LED, TFT, LCD, Seven Segment. 06

Reference Books

Sr. No.	*Title of Book*	*Author*	*Publisher/Edition*
1	Control System Engineering	R Anand Natarajan,P. Ramesh Babu	SciTech Publication
2	Modern Control Systems	K Ogata	Prentice Hall Publication
3	Automatic Control Systems	B.C. Kuo	Willey India Ltd. / Prentice Hall Publication
4	Automatic Control Engineering	F.H. Raven	Tata McGraw Hill Publication
5	Control Engineering	K. Ogata,	Pearson Education.
6	Automatic Control Engineering.	D. Roy and Choudhari	Orient Longman Publication Calcutta

B. Tech. Mechanical Engineering

		L L	T	C
MET 2704.1	**Mechanical Vibrations**	**03**	**--**	**03**

Course Description

This course explores the fundamentals of mechanical vibration, its classification. It also include different measures to control vibration and excessive noise.

Pre-requisites

FYT 101Matrices & Multivariable Calculus, FYT 108 Applied Mechanics.

Course Objectives

1 Study basic concepts of vibration.
2 Acquaint with the principles of vibration measuring instruments.
3 Create awareness about principles of sound level measurement and noise.

Course Outcomes

Students will be able to

CO 2704.1	Develop mathematical model to represent dynamic system.	3
CO 2704.2	Estimate natural frequency of mechanical system.	4
CO 2704.3	Analyze vibratory response of mechanical system.	4
CO 2704.4	Measure various vibration parameters.	4
CO 2704.5	Interpret relevance of noise in mechanical systems.	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	100	100	--	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2704.1	2	2	1	1									2	
CO 2704.2	2													2
CO 2704.3					2				2					
CO 2704.4					2				2					2
CO 2704.5		2												2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2704.1	**Mechanical Vibrations**	**03**	**--**	**03**

Course Content Hrs

Unit 01 **Introduction:**

CO 2704.1 Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Motion – periodic, non-periodic, harmonic, non- harmonic,

	Degree of freedom, Static equilibrium position, Vibration classification, Steps involved in, vibration analysis, Simple harmonic motion, Vector and Complex method of representing, vibration, Fourier series and harmonic analysis.	04
Unit 02 CO 2704.2	**Single DOF System :** a) Undamped free vibrations, Damped free vibrations, Types of damping, Logarithmic decrement and damping materials. b) Forced Vibrations: Types of excitation, Forced excitation, Support excitation, Excitation due to unbalance in machines, Response of systems to above types of harmonic excitations, Transmissibility-Force transmissibility and motion transmissibility, Vibration isolators, commercial isolation materials and shock mounts.	08
Unit 03 CO 2704.3	**Two DOF System :** a) Free undamped vibrations – Principal modes and natural frequencies, Co-ordinate coupling and principal co-ordinates. b) Forced vibrations (Undamped) – Harmonic excitation, Vibration Dampers and absorbers, Dynamic vibration absorber – Tuned and Untuned type	08
Unit 04 CO 2704.3	**Introduction to Multi DOF System :** a) Free vibrations of Multi DOF System-Flexibility and stiffness influence coefficient matrix, Equation of motion b) Rayleigh's method, Matrix iteration method and Holzer method	07
Unit 05 CO 2704.4	**Vibration Measuring Instruments :** Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, Sensors and Actuators, Introduction of X – Y plotter, Spectral analyzers, Exciters FFT analyzer. Introduction to Condition Monitoring and Fault Diagnosis	05
Unit 06 CO 2704.5	**Introduction to Noise :** **a) Sound Level and Subjective Response to Sound** Frequency dependent human response to sound, Sound pressure dependent human response, Decibel scale, Relation among sound power, Sound intensity and sound pressure level, Octave Band Analysis. **b) Noise- Effects, Rating and regulation** Non auditory effects of noise on people, Auditory effects of noise, Noise standards and limits, Ambient emission noise standards in INDIA, Hazardous noise explosion, Day night noise level, Noise sources and control, Automotive noise control principles, Sound in enclosures, Sound energy absorption, Sound transmission through barriers.	08

Reference Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Mechanical Vibrations	SingiresuS.Rao	Pearson Education,	ISBM –81-297-0179-0 -(2004).
02	Mechanical Vibrations	G. K. Grover,	Nemchand and Brothers, Roorkee	
03	Mechanical Vibrations	Dr. V. P. Singh,	S. Chand and Sons New Delhi.	
04	Theory of Vibrations with Applications	W. Thomson	Pearson Education,	2nd Edition
05	Mechanical Vibration and Noise Engineering	A. G. Ambekar	Prentice Hall of India	

B. Tech. Mechanical Engineering

Final Year (Semester – VII)

MET	Supply Chain Management	L	T	C
2704.2		03	--	03

Course Description

Supply Chain Management is having its own importance in industry from designing a product to purchasing of raw materials to manufacturing to supply of prod uct to vendors or customers. The various stages in the process have their own demand and supply of inventory /material or information. This course covers the importance of individual stage's requirements, design parameters and related issues to design a Supply Chain for an industry.

Pre-requisites

Production & Operations Management MET308.2, Manufacturing Processes MET205

Course Objectives

To familiarize the students with the concepts of supply chain management.

To acquaint key features of a network configuration in supply chain network.

To introduce the concepts of global logistics and risk management and international issues in Supply Chain.

Course Outcomes	Students will be able to,	Bloom's Level
CO 2704.2	Design inventory management along with costing. (case basis)	4
CO 2704.2	Design Distribution Strategies & strategic alliance for an industry (case basis)	4
CO 4073R1	Design Economic Transportation, information technology to manage supply chain for national and international issues. (case basis)	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100	--	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2704.2.1	2	2	2		1						3	2		
CO 2704.2.2	2	2	2		3						3	2		
CO 2704.2.3	2	2	2		3						3	2		

Course Content Hrs

Unit 01 CO 2704.2.1 **Introduction to Supply Chain Management & Logistics Network Configuration**
What is Supply Chain Management, Key issues in Supply Chain Management, Data Collection, Data Aggregation, Transportation Rates, Mileage Estimation, Warehouse Costs, Warehouse Capacities, Potential Warehouse Locations, Service Level Requirements, Future Demand, Model and Data Validation, Solution Techniques – Heuristics and need for exact algorithms, Simulation Models and Optimization Techniques. 06

Unit 02 CO 2704.2.2 **Inventory Management, Order Costs**
Economic Lot Size Model, Effect of Demand Uncertainty, Multiple Order Opportunities, No Fixed Order Costs, Fixed Order Costs, Variable Lead Times, Risk Pooling, Centralized Versus Decentralized Systems, Managing Inventory in Supply Chain, Practical Issues. 06

Unit 03 CO 2704.2.3 **Designing Supply Chain Networks**
Bullwhip Effect, Quantifying the Bullwhip Effect, Impact of Centralized Information on the Bullwhip Effect, Methods for Coping with the Bullwhip Effect, Effective Forecasts, Information for Coordination of Systems, Locating Designed Products, Lead Time Reduction, Integrating the Supply Chain, conflicting objectives in the Supply Chain, Designing the Supply Chain for Conflicting Goals. 06

Unit 04 CO 2704.2.4 **Distribution Strategies and Strategic Alliances**
Centralized versus Decentralized Control, Distribution Strategies, Direct Shipment, C ross Docking, Transshipment, Central versus Local Facilities, Push versus Pull systems. Framework for strategic alliances, Third Party Logistics and related issues, Retailer Supplier Partnerships and related issues, Distributor integration. Design for Logistics & Economic Transportation. 06

Unit 05 **Reverse Supply Chain** 08
Introduction, Reverse Supply Chain v/s Forward Supply Chain, Types of Reverse Flows, Issues in Management of Reverse Supply Chain, Reverse Supply Chain for Food items, Reverse Logistic and Environment Impact. Integration & Collaborative Supply Chain Introduction, Evolution of collaborative SCM, Efficient Customer response, Collaboration at various levels, Imperatives for Successful Integrative Supply Chains.

Unit 06 **Agile Supply Chain** 08

Introduction, Source of Variability, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain. Cases of Supply Chain Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.

Reference Books

Sr. No.	*Title of Book*	*Author*	*Publisher/Edition*	
01	Designing & Managing the Supply Chain: Concepts, Strategies & Case Studies	Simchi-Levi, D. Kaminsky, P. Simchi-Levi, E. and Ravi Shankar	McGraw Hill	Third Edition, 2008
02	Purchasing & Supply Chain Management Text and Cases.	Doebler, D.W. and Burt, D.N.	McGraw-Hill	1996
03	Supply Chain Management: Strategy, Planning & Operations	Sunil Chopra , Peter Meindl	Pearson Education	Sixth Edition,2014
04	Competitive Advantage	Porter, Michael E	The Free Press. New York	

Final Year (Semester – VII)

MET 2705.1 **Design of Mechanical Systems** **03 -- 03**

Course Description

Course deals with the design of mechanical systems & concepts of optimisation.

Pre-requisites

MET 302, Design of Machine Elements, MET 209, Strength of Materials

Course Objective

To familiarize the students with concepts of optimisations of mechanical components along with design of mechanical systems such as breaks, clutches, gear boxes & pressure vessels.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 2705.1.1	Study the design of various mechanical systems such as pressure vessel, brakes & clutches.	3
CO 2705.1.2	Design and analyse the gear box for machine tool applications.	3
CO 2705.1.3	Study the concepts of optimization of mechanical elements.	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP
Contribution	15%	15%	20%	50%	--
Passing	40%			40%	--
Planned Marks	30	30	100	100	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 4091R1.1	2	2										2		2
CO 4091R1.2	2	1										1		2
CO 4091R1.3	2	2										2	2	2
	(1 – Low, 2 – Moderate, 3 – High)													

	Course Content	Hrs
Unit 01	**Pressure Vessel Design:** Thin and thick cylinders; failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels- Horizontal and vertical; Classification of pressure vessels, Shell and end closures. Effectof opening & nozzles in shell & covers. Types of pressure vessel support.	06
Unit 02	**Design of Clutches & Brakes:** Design of Clutches: Single plate, multi plate and cone clutches. Design of Brakes: Block and Band brakes: Self-locking of brakes: Heat generation in Brakes.	06
Unit 03	**Design of Gear boxes for machine tool applications :** Determination of variable speed range- Graphical representation of speeds- Structure diagram- Deviation diagram- Ray diagram- Selection of optimum ray diagram- Difference between number of teeth of successive gears in a change gear box- Analysis of twelve speed gear box	08
Unit 04	**Optimum Design:** **Objectives of optimum design:** Johnsons Method of Optimum Design (MOD), Adequate and optimum design. Primary, Subsidiary and Limit equations- Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring.	06
Unit 05	DESIGN OF I. C. ENGINE COMPONENTS: Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin	08
Unit 06	OPTIMUM DESIGN: Objectives of optimum design- Johnsons Method of Optimum Design (MOD), Adequate and optimum design. Primary, Subsidiary and Limit equations- Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring. Introduction to optimum design with Langrange Multiplier.	06

MET 2705.2	**Industrial Engineering and Management**	**03**	**--**	**03**

Course Description

It is the program vertical course from manufacturing technology vertical in semester VII. It includes principles of management, tools & techniques of industrial engineering & project management. It also covers maintenance management and replacement model along with advanced industrial engineering techniques.

Pre-requisites

308.2 Production & Operations Management, Manufacturing Processes

Course Objectives

1 To implement different concepts involved in methods study and understanding of work contentin different situations.

2 To acquaint the students with various advance techniques in industrial engineering.

3 To introduce the concepts of project planning and control and maintenance management.

	Course Outcomes *Students will be able to*	Bloom's Level
CO 2705.2.1	**Use** different management concepts for solving various problems of an organizations.	3
CO 2705.2.2	**Devise** the better method for performing the job/operation including calculation of its standard time.	4

	Course Content	Hrs
Unit 01	**Principles and Concepts of Management :** Definition, Characteristics, Development of management thoughts, Functions of management, Planning, Organizing, staffing, Directing- leading and motivation, Controlling and coordination, Functional Areas of management. Forms of business organisation, organisation structure, organisation behaviour, industrial psychology, Management by objective, Management information system. Case studies based on functions of management.	06
Unit 02	**Industrial Engineering :** Definition, Scope, tools and techniques of industrial engineering, **Productivity** - Concept of Productivity, Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity. **Method Study** - Objectives, Steps Involved in Method Study, Different Recording Techniques, principles of motion economy, Application of different recording techniques. **Work Measurement** - Objectives, Techniques of Work Measurement, Steps Involved in Time Study, Steps and Equipment of Time Study, Performance Rating. Case studies of Method study & work measurement	06
Unit 03	**Ergonomics and project planning & Control :** Objectives, Ergonomics productivity and working environment, Man-Machine System, Display System, Design of controls, Environmental factors, Anthropometry, Manual material handling, physiological aspects of muscular work, Workplace Design, Workstation ergonomics. Network analysis with PERT and CPM Comparison between CPM and PERT, **Critical Path Method (CPM)** - Forward pass, Backward pass, Critical Path, Estimation of project duration, Time-cost trade off **Program Evaluation and Review Technique (PERT)** - Three-time estimates, Probability of completion of the project within a scheduled time. Case studies based on project management.	06
Unit 06	**Advanced Industrial Engineering Techniques :** **Decision Theory** - Introduction, Decisions under uncertainty, Expected Monetary Value (EMV), Expected opportunity loss (EOL), Expected value of perfect information (EVPI), Decision Trees **Value Stream Mapping** - Definition, Purpose of value stream mapping, steps involved in VSM, Advantages and applications. **Simulation Technique** -Process of simulation, various techniques of simulation, Monte-Carlo simulation, problem formulation, data collection and analysis, random- variable generation, model development, scenario experimentation, statistical analysis of output, and resultant decision management, application of simulation to i nventory system and queuing model **Activity Based Costing** - Introduction to concepts of costing, Definition of ABC, Objectives and Methodology of ABC, Application, Implementation and limitations of ABC. **QMS (ISO 9001)** - Objectives, Quality Management standards, Requirements to implement QMS, Steps for implementation, Benefits of QMS.	06

B. Tech. Mechanical Engineering

Final Year (Semester – VII)

		P	C
2706	**Refrigeration and Air Conditioning lab**	**02**	**01**

Course Description

The course gives the practical approach and understanding of refrigeration systems and itsapplications in finding the COP.

Pre-requisites

MET-207 Thermodynamics, MET-307 Heat and Mass Transfer

Course Objectives

1 Acquire basic knowledge about different refrigeration systems.
2 Basic knowledge of load calculations for air conditioning systems.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 2706.1	Identify the various components of refrigeration and air conditioning system	02
CO 2706.2	Demonstrate refrigerant charging in hermetically sealed compressor.	04
CO 2706.3	Experiment with various systems of refrigeration systems.	03
CO 2706.4	Experiment with various systems of air conditioning systems.	03

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	--	--	--	--	100%	100%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	50	50

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2706.1	3													
CO 2706.2	2													
CO 2706.3		2												
CO 2706.4						3								
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2706	**Refrigeration and Air Conditioning lab**

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
Lab 01	Study of various conventional and Nonconventional methods of refrigeration.	02

Lab 02	Study and demonstration of refrigeration system. (water cooler, refrigerators, chiller, ice plant and cold storage).	02
Lab 03	Trial on Refrigeration Test Rig. (vapour compression system)	02
Lab 04	Trial on heat pump test rig.	02
Lab 05	Study and trial on vapour absorption system	02
Lab 06	Trial on ice plant test rig	02
Lab 07	Study and demonstration on air conditioning systems. (Unitary and central air conditioning / system)	02
Lab 08	Trial on window air conditioner or Air Conditioning Test Rig	02
Lab 09	Visit to central air conditioning or cold storage or dairy plant or ice plant related with refrigeration and air conditioning system.	02
Lab 10	Market survey of various refrigeration and air conditioning systems which include the equipment with related specifications, manufacturers, cost and comparison with respect to tonnage, coat and presentation of report in the laboratory.	02

Reference Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Refrigeration and Air Conditioning	C. P. Arora	Tata McGraw Hill	1981,2nd Edition
02	Basic Refrigeration And Air Conditioning	P N Ananthanarayan	Tata McGraw Hill	3rd Edition, (1981)
03	Principles of Refrigeration	Roy J. Dossat	Pearson Education	4th Edition
04	Refrigeration and Air Conditioning	Stoker		

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

		P	C
MET 2707	**Industrial Hydraulics and Pneumatics Lab**	**02**	**01**

Prerequisites	Fluid Mechanics MET208
Tools Used	Required Tools /Machinery /Equipment /Software /Other
1	Hydraulic trainer kit
2	Pneumatic trainer kit
3	Fluid simulation software

Course Outcomes		Level
CO 2707.1	**Interpret** symbols for hydraulic and pneumatic systems	02
CO 2707.2	**Explain** the different elements of hydraulic and pneumatic system	02
CO 2707.3	**Develop** hydraulic and pneumatic circuits for different applications	03

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	--	--	--	--	100%	100%
Passing	--			--	40%	40%
Planned Marks	--	--	--	--	50	50

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2707.1	2							2		2		2		
CO 2707.2	1											2		
CO 2707.3			2							2		2		2
	(1 – Low, 2 – Moderate, 3 – High)													

Mapping of COs with POs :

Course Content

	Activity	Hrs
Lab 01	Study of ISO/JIC Symbols for hydraulic and pneumatic systems	02
Lab 02	Study of Hydraulic and Pneumatic system components	02
Lab 03	Study of different types of valves used in hydraulic and pneumatic system.	02
Lab 04	Circuit preparations on hydraulic trainer kit.	02
Lab 05	Circuit preparations on pneumatic trainer kit.	02
Lab 06	Circuit preparations using fluid simulation software	02
Lab 07	Troubleshooting and maintenance of Hydraulic and Pneumatic systems	02
Lab 08	Industrial Visit to study industrial hydraulic and pneumatic system	02

MET 2709 **Software Proficiency – III**
ANSYS (Structural)

Experiment No	Description
1	Assignment on a) Types of elements, b) Choice of element, c) Type of meshing
2	Finite Element Analysis of Stepped Bar (1D)
3	Static Analysis of different types of beam (1D)
4	Static Analysis of various truss structures (2D)
5	Static Analysis of Plate with a circular hole (2D & 3D)
6	Static Analysis of Wall Bracket (2D & 3D)
7	Buckling Analysis of Column (2D)
8	Thermal Analysis of Fin (1D & 2D)
9	Modal Analysis of Beam (3D)
10	Coupled Structural/Thermal Problem (3D)

Reference Books

1 "Introduction to Finite Elements in Engineering", Chandrapatala, Belgundu, Prentice Hall of India, 3rd Edition.
2 Finite Element Analysis – Theory and Practice", M.J. Fagan, Longman Scientific and Technical.
3 "Practical Finite Element Analysis",N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite, Finite to Infinite Publication. 3. "Concepts of Finite Element Methods", Manicka Selvam, SCITECH publication.
4 NPTEL Lecture Series https://nptel.ac.in/courses/112104193/

B. Tech. Mechanical Engineering
Third Year (Semester – VII)

		P	C
MET 2710.1	**Mechanical Vibration Lab**	**02**	**01**

Course Description
This course includes measurement of different vibration and noise parameters.

Pre-requisites
FYT 101Matrices & Multivariable Calculus, FYT 108 Applied Mechanics.

Course Objectives
1 Demonstration of vibration systems.
2 Measurement of vibration parameters
3 Sound measurement at different locations

	Course Outcomes *Students will be able to*	Bloom's Level
CO 2710.1.1	Demonstrate free and forced vibration system.	02
CO 2710.1.2	Measure vibration parameters using vibration measuring instrument.	04
CO 2710.1.3	Analyze spectral response of vibrating machine using Fast Fourier Transform Analyzer.	04
CO 2710.1.4	Measure sound using sound measuring instrument	04

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	--	--	--	--	100%	--
Passing		--		--	40%	
Planned Marks	--	--	--	--	100	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2710.1.1	2													
CO 2710.1.2					2				1					
CO 2710.1.3					2				1					2
CO 2710.1.4					2				1					2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2710.1 Mechanical Vibration Lab

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
Lab 01 CO 2710.1.1	Experiment on equivalent spring mass system	02
Lab 02 CO 2710.1.1	Experiment on study of forced vibration characteristics	02
Lab 03 CO 2710.1.1	Determination of logarithmic decrement for single DOF damped system	02
Lab 04 CO 2710.1.1	Experiment on torsional vibration of two rotor without damping	02
Lab 05 CO 2710.1.1	Experiment on free vibration of a coupled pendulum and/or double pendulum	02
Lab 06 CO 2710.1.2	Study of different types of exciters for vibration analysis	02
Lab 07 CO 2710.1.2	Measurement of vibration parameters using vibration measuring instruments	02
Lab 08 CO 2710.1.3	Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.	02
Lab 09 CO 2710.1.3	At least two case studies in detail based on Conditioning Monitoring and Fault Diagnosis	02
Lab 10 CO 2710.1.4	Measurement of Noise by using noise measuring instruments	02

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	Name of Book /Handbooks /Catalogues	Author (s)	Publisher /Organization	Edition, Year of Publication, ISBN
01	"Mechanical Vibrations"	SingiresuS.Rao	Pearson Education,	ISBM –81-297-0179-0 -(2004).
02	"Mechanical Vibrations",	G. K. Grover,	Nemchand and Brothers, Roorkee	

03	"Mechanical Vibrations",	Dr. V. P. Singh,	S. Chand and Sons New Delhi.	
04	"Theory of Vibrations with Applications",	W. Thomson	Pearson Education,	2nd Edition
05	"Mechanical Vibration and Noise Engineering"	A. G. Ambekar	Prentice Hall of India	

B. Tech. Mechanical Engineering

Final Year (Semester – VII)

MET 2710.2 Supply Chain Management	P	C
	02	**01**

Prerequisites

Tools Used Required Tools /Machinery /Equipment /Software /Other

Course Outcomes	Students will be able to,	Bloom's Level
CO 2710.2.1	Identify key issues in implementation of Supply Chain Management	03
CO 2710.2.2	Identify risk parameters, safety issues in inventory and logistics.	03
CO 2710.2..3	Identify appropriate supply chain strategy for an organization.	03

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	--	--	--	--	100%	--
Passing	--			--	40%	--
Planned Marks	--	--	--	--	100	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2710.2.1	2	2	2		1						3	2		
CO 2710.2.2	2	2	2		3						3	2		
CO 2710.2..3	2	2	2		1						3	2		
	(1 – Low, 2 – Moderate, 3 – High)													

Course Content (Laboratory, Assignments, Mini Project, Seminar)

Sr. No.	**Activity**	Hrs
Lab 01	Group discussion on the key issues in Supply Chain Management	04
Lab 02	Group discussion on the Risk management issues in Supply Chain (Ex. Communication media, Smart Phones, TV, etc.)	04
Lab 03	Case study on Safety Inventories in a Supply Chain (Ex. Medical Surgery, etc.)	04
Lab 04	Case study on Designing Supply Chain Network (Ex. WalMart, DMart, StarBazar, etc.)	04
Lab 05	Exercise on identify appropriate supply chain strategy (National and/or International) (Ex. TATA Cliq, Amazon, Swiggy, Flipcart, etc.)	02
Lab 06	Case study on information technology used in Supply Chain	02

B Tech (Common to all Programs) Semester - VIIOPTIONS to Students (TRACKS)

Choices are given to students in terms of tracks to pursue their interest of study. In the B. Tech Semester VII, students are required to undertake the pre-work in respect of chosen tracks and this activity is assigned one credit. The tracks available to students are:

Track	Details of Track	Credit Assigned
Track 1	Industry Internship Program (IIP II) with project.	1
Track 2	Entrepreneurship Venture Scheme (EVS)	1
Track 3	Undergraduate Research Opportunity Program (UROP)	1
Track 4	Capstone project with Vertical and University Open Electives	1

Each student should choose one of the tracks at the beginning of the seventh (VII) Semester and the same track will continue through the B. Tech VIII Semester. Once selected the track in the VII semester, no change in track is allowed as pre-work is assigned to each of the selected track.

As a part of preparation to the selected track, a pre work is designed to pre pare the students for effectively completing the track in semester VIII and students are evaluated for their performance in assigned work through designed assessment schemes. This pre-work is assigned one credit.

B Tech (Common to all Programs) Semester - VII

Track 1: Industry Internship Program (IIP-II) with Project [Phase – I]

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	% WT	% Pass
II-401	Industry Internship Program (IIP-II) with project.	-	-	2	1	Proj	FEP	100	Min 50

Students who opt for Track 1: Industry Internship Program (IIP-2) with project are expected to complete the following activities during the semester VII and during the winter vacation once the company is assigned to thestudent for internship.

1. Student is required to collect all the relevant information about the company prior to making the first visit tothe company. The following information is to be collected preferably through the secondary sources like company website, brochures, company annual reports, personal contact, newspaper and magazine publications.
2. The information collection includes.

a. Company Profile, Vision, mission, establishment, promoters, location, organization structure, type of the business, turnover of the company.

b. Products and services, customers / clients.

c. Departments / Sections, production process / service process.

d. Positioning of the company with respect to competitors.

e. Product / Process /Service / Solution technologies deployed.

3. With permission from the company, on confirmation of internship, make the first visit to the company for familiarization and spend a day or two during the Semester on weekly holidays or if it is far off, during winter break

make a scheduled visit. Make a visit report in a professional way and include in the report you submit to department.

4. The guide / supervisor will be assigned to you once your industry / company is finalized.

Eligibility Criteria Eligibility Criteria for allotment of the tracks.

1. Student should have a CGPA of more than 6.75 on a 10-point scale without any back logs.
2. Students are ready to move to a place of company allotted.
3. Required to follow all the rules and regulations of the company.
4. Ready to bear the expenses of internship if the company charges, accommodation and transport.
5. Should be able to complete the track I in the company including evaluation.

Evaluation:

This is a credit course (one credit). The scheme of evaluation will be based on the assessment rubrics.

Evaluation Component	Weightage	Minimum Passing
FET	100%	50%

B Tech (Common to all Programs)
Semester - VIITrack II: Entrepreneurship
Venture Scheme Phase – I

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	% WT	% Pass
ED-401	Entrepreneurship Venture Scheme (EVS)	-	-	2	1	Proj	FEP	100	Min 50

This track is designed for students aspiring for staring their own enterprise / new start up and has a burning desire to become an entrepreneur. Though CGPA is not the only criteria for selection, a student is required to go through awell-structured process of selection and also an interaction with parents.

During the 7th Semester, students are expected to be familiar with the traits t make a successful entrepreneur. Personal SWOT analysis and area in which he wants to think of taking up the business venture.

The activities for the Semester - VII include:

1. Self-analysis report and action plan for improvement of overall personality.
2. Interaction with minimum three entrepreneurs. Preferably one each from first generation entrepreneur, family business and women entrepreneur. Study and observe closely how they have built their units, their vision, planning, resource mobilization, style of working, risk taking ability and other personality dimensions make a brief report.
3. Study a unit started by a young entrepreneur and prepare a report with the following details:

a. The beginning (start) Brief Profile of company, Products / Services, sources of Finance
b. Customers
c. What is special about the company? How they compete in the market
d. What is the Financial Health?
e. How they leverage technologies and all other aspects of running an enterprise

Eligibility for choice of this track

1. Student should possess the right attitude and mind set to start his venture assessed through the test and personal interview.
2. Interaction with parents is mandatory to seek the support and co-operation to their wards for starting a

new venture.

3. Students are required to work hard to interact and connect with entrepreneurs. Complete the other courserequirements mentioned in the track.

Evaluation:

Evaluation Component	Weightage	Minimum Passing
FET	50%	50%
Report & Presentation	50%	

During vacations, the student is expected to undergo the EDP program and produce the certificate.

B Tech (Common to all Programs) Semester - VII

Track III: Undergraduate Research Opportunity Program (UROP) Phase I

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	% WT	% Pass
RE-401	Undergraduate Research Opportunity Program (UROP)	-	-	2	1	Proj	FEP	100	Min 50

Undergraduate Research Opportunity Program (UROP) track is specially designed for students who would like to make their career in research, wish to pursue graduate programs (M.Tech) in reputed institutes a nd want to study abroad for Master's program (MS) and get a good opportunity to work with R&D departments of company. At the beginning of the academic year, the department is going to publish the details like list of Faculty available to guide UROP, the number of candidates they can guide, Research area and the brief note of research projects they can offer.

Activities students are expected to carry out for Phase I

1. Selection of research project area and the research supervisor (to be confirmed by department based onprefixed criteria)
2. Make a literature survey by collecting the relent details and making a review of the literature.
3. Identify the research topic and decide the research project title under the guidance of a supervisor.
4. Make a research proposal which is to be worked out in Semester II in a standard format.

Eligibility requirements

1. The interest and passion for research judged through prior projects done, participated in researchcompetitions and publications in conferences.
2. A good academic performance with a CGPA greater than 8.5 at the end Semester VI with no back logs.
3. Ready to work hard on a chosen topic to get the desired outcomes.
4. Students who get opportunity to carry out this track in premier institutions are required to meet theadditional expenses incurred.

Evaluation

Evaluation Component	Weightage	Minimum Passing
FET	50%	50%
Research Proposal Report & Presentation	50%	

The final proposal evaluation will be evaluated by a committee appointed by the Head of the department. If the committee recommends the proposal, student can start the work in vacation and if the committee

suggests modification, changes in scope, the student is required to complete and resubmit the same for final approval and on approval can start the work.

Students can take up the research projects outside the university premises like Government R&D laboratories, DRDO, Auto Vehicle Testing Labs, etc., reputed premier Institutes like IIT's and R&D Organizations.

B Tech (Common to all Programs)
Semester - VIITrack IV :
Capstone Project

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	% WT	% Pass
CP-401	Capstone project with Vertical and University Open Electives	-	-	2	1	Proj	FEP	100	Min 50

As a part of the B. Tech curriculum, each student is required to undertake a project in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VII Semester towards earning prescribed credit are as follows:

1. Formation of a project team not exceeding Five Students.
2. Allotment of a Faculty Supervisor to each group.
3. Student group can choose the Projects offered by the faculty guides or can come out with project ideas to be finalized in consultation with project guide / supervisor or can carry out the industry sponsored projects in groups.
4. Student Group is required to prepare the project proposal in a standard format for approval.
5. Student group will present the project proposal to an evaluation committee appointed by the Head of theDepartment.
6. On approval of the Project Proposal, students can start the project. If there are any suggestions bycommittee, the students are required to rework on the project proposal and submit incorporating all suggestions.
7. Students have a choice to make their own groups

General guidelines for selection of a Project:

1. Design, Fabrication and testing of a product / machine.
2. Improvement in the existing system. Augment of performance of the existing system.
3. Solution to the existing problem using innovative problem-solving techniques.
4. Optimization techniques using heuristics.
5. Developing application software's.
6. Application of Industrial Engineering / Optimization tools to solve industry problems.
7. Modeling and analysis and Optimization Projects.
8. Projects with technical solutions to the Social Problems.
9. Solving Industry related problems.
10. Extensive data collection, data analysis using computers and optimal solution.

The list is not exhaustive. Students can identify feasible of thi s project beyond the list.

Evaluation:

Evaluation will be based on the assessment rubrics designed to assess the project proposal

Evaluation Component	Weightage	Minimum Passing
FET	50%	50%
Project Synopsis	50%	

Semester – VIII

B Tech (Common to all Programs) Semester – VIII

TRACK – I : Industry Internship Program (IIP-II) with Project

	Industry Internship Program 18 Weeks									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	% WT	Pass
I	II-402	Industry Internship II	-	-	-	6	Practical Training (OJT)	FEP	100	Min 50
	II-404	Industrial Project	-	-	-	6	Project	FEP	50	Min 50
								POE	50	
	II-406	Online Course in Advanced Technology (domain area)	-	-	-	4	--	FET	100	Min 50
	II-408	Self-Study Course (Non-Instructional)	-	-	-	4	Report & Presenta-tion	FET	100	Min 50
		Total	**-**	**-**	**-**	**20**	Total Credits: **20**			

Note

Students are required to spend entire semester-VIII in industry allotted and complete the project individually in the company where the students are doing his internship.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program;
ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program;
CP – Capstone Project; UE – University Open Elective

Semester – VIII
B Tech (Common to all Programs) Semester - VIII

TRACK – II : Entrepreneurship Venture Stream (EVS)

	Entrepreneurship Venture Stream (EVS)									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
II	ED-402	Product /Service identification & Feasibility Study of Project	3	-	-	03	Project Report & Presentation	FET	100	Min 40
	ED-404	Techno Economic Feasibility of Identified Venture & DPR	1	-	06	06	Assessment by Professional/s	FEP	50	Min 50
								POE	50	
	ED-406	Marketing for Entrepreneurship	2	-	-	02	Theory	FET	20	Min 40
								CAT	30	
								ESE	50	Min 40
	ED-408	Finance for Entrepreneurs	3	-	-	03	Theory	FET	20	Min 40
								CAT 1	15	
								CAT 2	15	
								ESE	50	Min 40
	ED-410	Training in EDP Program (Minimum 1 Week)	1	-	-	01	Certification	FET	100	Min 50
	ED-412	Mentoring & Guidance by an Entrepreneur/s	1	-	-	01	Assessment by Mentor	FEP	100	Min 50
	ED -414	Online Course in Advanced Technology (domain area)	-	-	-	04		FET	100	Min 50
		Total	**10**	**-**	**06**	**20**	Total Hrs: **16**, Total Credits: **20**			

Note

Note Students are required to spend entire semester VIII in preparing DPR and the DPR will be evaluated by a competent Bank authority/Chartered accountant for feasibility individually in the company w here the students is doing his internship.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program;
ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program;
CP – Capstone Project; UE – University Open Elective

Semester – VIII
B Tech (Common to all Programs) Semester - VIII

TRACK – III : Undergraduate Research Opportunity Program (UROP)

	Undergraduate Research Opportunity Scheme - UROP									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
III	RE-402	Research Methodology	3	1	-	04	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	RE-404	Research Project	-	-	12	06	Project	FEP	50	Min 50
								POE	50	
	RE-406	Research Elective	3	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	RE-408	Research Laboratory (As per Elective)			2	01	Practical	FEP	100	Min 50
	RE-410	Research Outcomes (Patents, Publications, Presentations)	-	-	-	02	Outcomes	FET	100	Min 50
	RE -412	Online Course in Advanced Technology (domain area)	-	-	-	04		FET	100	Min 50
		Total	**06**	**01**	**14**	**20**	Total Hrs: **21**, Total Credits: **20**			

Note

Students are required to spend minimum 12 hours on research project under the instructions from supervisor as per the time table.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

Semester – VIII
B Tech (Common to all Programs) Semester - VIII

TRACK – IV: Capstone Project with Program Verticals & University Open Electives

	Capstone Project (with Program Verticals & University Open Electives)									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
IV	MET-419.X	Programme Elective – V (as per Vertical)	03	01	-	04	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	UE-402.X	University Open Elective I	03	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	UE-404.X	University Open Elective II	02	-	-	02	Theory	FET	20	Min 40
								CAT	30	
								ESE	50	Min 40
	CP-402	Capstone Project	-	-	12	06	Project	FEP	50	Min 50
								POE	50	
	CP-404	Career Planning & Corporate Readiness Program	-	-	02	01	Student Portfolio Grading	FET	100	Min 50
	CP-406	Online Course in Advanced Technology(domain area)	-	-	-	04		FET	100	Min 50
		Total	**08**	**01**	**14**	**20**	Total Hrs: **23**, Total Credits: **20**			

Note

Students are required to spend minimum 12 hours on project under the instructions from supervisor as per the time table.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

INFORMATION ABOUT TRACKS

B Tech (Common to all Programs) Semester – VIII

TRACK – I : Industry Internship Program (IIP-II) with Project Phase – II

1 INTRODUCTION

Sanjay Ghodawat University place high focus on the interaction with industries to give them adequate exposure to the practicing aspects of theoretical knowledge they learn in classroom. Moving a step ahead, in order to enhance the students experience with world of work, we are introducing industry internship with project after a through consultation with industry persons, academicians as a part of the major curricular reforms in the choice based credit system (CBCS).

Choice Based for students at Semester VIII for full semester (16 weeks) and pre-work at semester VII (Preparation).This track aims at giving students hands on experience with the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long (16 Weeks) course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

This course aims at giving students hands on experience to the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

IIP track has two components

1. Internship training in the industry for full semester.
2. Individual Project Assignment in the same company

2 CRITERIA FOR SELECTION OF STUDENTS

The students who want to opt for IIP II and project track are required to fulfill the criteria specified below:

1. CGPI of students up to semester VI should be ≥ 6.75 (with no backlogs)
2. Ready to move to the place where industry assignment is allotted.
3. The entire cost of the Internship will be borne by the students (lodging boarding and any other cost).However, any facilities extended by the company like conveyance facility, subsidized canteen facility and stipend the students can avail.
4. They have to go through the selection process of the company if required.
5. Maximum number of students will be decided based on the policy guidelines prepared by the university/Department and also availability of internships at industries from time to time.
6. Once the student is allotted the company (after final selection process) cannot be changed and it is binding on the student to complete the assignment in that company.

3 CRITERIA FOR LISTING OF COMPANIES

1. It should be a medium or large scale industry having the functional departments and facilities to design develop and manufacture the products or offer services and potential to offer challenging projects.

2. Company should provide minimum 2-3 internship assignments along with projects and extend facilities to students the on the job training (OJT) as well as access to data & information and guidance to complete the assigned project.

3. Should be able to keep record of attendance and provide a mentor to monitor the project and
4. help the students to sort out problem/ issues.

5. Students who are eligible as per criteria and get the internship with their own contacts can
6. also be considered subjected to approval of the company by the University for Internship.

4 PROJECT ASSIGNMENT

A student doing internship in the company is required to carry out an individual project in the domain specific area with help of company mentor/Guide and faculty guide assigned to qualify for the credits mentioned in structure and also required to undergo self-study or online certification course approved by Department Program Committee of the host department.

The project proposal is to be prepared and get approved by the DPC of the department student is required select the problem for solution which requires a problem definition, data Collection, analysis and implementation of the solution, Design ,fabrication and testing as applicable (It is not a just company Internship Report)

5 INDUSTRY INTERNSHIP AND PROJECT MONITORING

A team of faculty members from the institute assigned will monitor closely the progress of training and project and helps to sort out any issues concerned. The institute faculty accountability includes proper orientation of student in the company, helping in finalizing project assignments, mentoring the student for overall effectiveness of internship program and a liaison between companies, student and the department.

6 OUTCOME EXPECTED AT THE END OF IIP II

After the successful completion of the IIP-2, the student should be able to

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts that is being studied.
6. Improve the leadership abilities, communication.
7. Demonstrate project management and finance and cost management skills

7 OUTCOME EXPECTED FROM PROJECT

After the successful completion of the project, the student should be able to;

1. Identify the project/problem in the domain of program and relevant to the company.
2. Collect the information to the pertaining to the problem identified.
3. Analyze the information using the statistical tools/ techniques.
4. Suggest the feasible alternative solution and select the best solution.
5. Present the solution to the company and seek assistance in the implementation.
6. Measure the impact of the project on the performance of company/department/section.

8 INTERNSHIP MONITORING

Each student is assigned a faculty mentor by the program department who monitors the progress of both the internship and project and helps the student to sort out any issues/ problems faced by the students. The faculty is scheduled to make five visits during the internship

1	At the beginning of the program for orienting students to the company.	Prior to the program or during First week of program
2	Finalization of project proposal	During 4th week
3	Mid of the program (to review program)	Between 8th and 9th Week
4	Final progress review	During 15th week
5	At the end of the internship for evaluation	During16 the week

Note: Apart from these scheduled visits, the faculty on request of students/company will visit in case of any issue related to the internship /project.

9 WORK DIARY

Each student is provided with a diary which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done an d write the remarks/ instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

10 EVALUATION OF INTERNSHIP: (4 CREDITS)

The assessment of the internship will be done jointly by the industry and the faculty ass igned to the students. The tentative scheme of assessment will be

1.	Punctuality, behavior and following code of conduct (to be assessed by the company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal)	20%
4.	Final evaluation based on presentation of work, internship report (jointly by the company personnel and examiner appointed by institu te & faculty guide.	40%

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

11 EVALUATION OF THE PROJECT (6 CREDITS)

1.	Project/Problem identification and preparation of project proposal approved by both the company and faculty endorsed by the DPC	20%
2.	Mid review of the project as per schedule specified jointly by company and faculty assigned.	30%
3.	Final examination of the project along with detailed project report (industry person + Faculty guide + External examiner, either at institute/company as per the convenience)	50%

The student is required to complete both internship and project successfully to become eligible for award of the degree along with the credits for the self-study/online/certification courses.

A special certificate will be awarded to student by the university along with B Tech Degree after successful completion of IIP II and Project in industry.

Special Note: The terms of reference are subjected modifications as per the prevailing conditions at the time and academic council decision in this respect is final and binding to all the concerned with this track I

CURRICULUM

B Tech Semester - VIII (All Programs)

TRACK – I : Industry Internship Program (IIP-II) with Project

	Industry Internship Program 18 Weeks									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	% WT	Pass
I	II-402	Industry Internship II	-	-	-	6	Practical Training (OJT)	FEP	100	Min 50
	II-404	Industrial Project	-	-	-	6	Project	FEP	50	Min 50
								POE	50	
	II-406	Online Course in Advanced Technology (domain area)	-	-	-	4	--	FET	100	Min 50
	II-408	Self-Study Course (Non-Instructional)	-	-	-	4	Report & Presenta-tion	FET	100	Min 50
		Total	**-**	**-**	**-**	**20**	Total Credits: **20**			

Note

Students are required to spend entire semester-VIII in industry allotted and complete the project individually in the company where the students are doing his internship.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

B.Tech Semester - VIII (All Programs)
TRACK – I : Industry Internship Program (IIP-II) with Project

II-406 : Online Course (MOOCS)

Student should register for the online course of minimum 2 weeks offered by SWAYAM, NPTEL, Courseera or any other authorized platforms. The courses which the student registers should be advanced in the domain area and should be able to help students in the project assignment they are doing in company. The courses are to be approved by the committee appointed by the department. Student should complete the course and after the examination should produce a certificate. Unless student produces the grade certificate to the department, the course will not be complete. Course will be graded based on certificate credentials mentioned on the certificate by the authorized agency.

Evaluation

Certification with grades	**100%**

Note: The students should preferably register for the course in consultation with coordinator, MOOCS, Sanjay Ghodawat University Kolhapur.

II-408 : Self Study Course

Students who choose Industry Internship Program (IIP II) and Project should undergo a self-study course of one credit. The objectives of this self-study course are to give freedom to choose the course of interest area and promote lifelong learning. It also helps to develop independent learning without the instructors.

The skills and outcomes expected at the end of the course is student will be able to choose the course from variety of courses available, plan and organize the study, Collect the information from relevant sources and prepare a concise report and give presentation about what he has learnt. A guide is allotted to the student to finalize the course title and contents. The courses student opts should not have been the part of curriculum for the program of study.

The following types of courses may be selected by the student:

1. Advanced technology courses from any domain area of technology.
2. Course in the area of Music, Drama, Fine arts and Literature. Journalism.
3. Courses in the area of sports, travel and tourism
4. Courses in contemporary issues in Management, economics and Social Issues.
5. Any foreign language or Indian Language (Which you do not know).
6. Courses on nature, philosophy and Indian history.

The list is not exhaustive and you can choose the courses other than areas listed here.

Evaluation
Student is evaluated based on the report and presentation with assessment rubrics.

FET (In semester Evaluation)	50%	Minimum Passing
ESE (Report and Presentation)	50%	50%

B.Tech Semester - VIII (All Programs)

TRACK – II : Entrepreneurship Venture Stream (EVS)

	Entrepreneurship Venture Stream (EVS)									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
II	ED-402	Product /Service identification & Feasibility Study of Project	3	-	-	03	Project Report & Presentation	FET	100	Min 40
	ED-404	Techno Economic Feasibility of Identified Venture & DPR	1	-	06	06	Assessment by Professional/s	FEP	50	Min 50
								POE	50	
	ED-406	Marketing for Entrepreneurship	2	-	-	02	Theory	FET	20	Min 40
								CAT	30	
								ESE	50	Min 40
	ED-408	Finance for Entrepreneurs	3	-	-	03	Theory	FET	20	Min 40
								CAT 1	15	
								CAT 2	15	
								ESE	50	Min 40
	ED-410	Training in EDP Program (Minimum 1 Week)	1	-	-	01	Certification	FET	100	Min 50
	ED-412	Mentoring & Guidance by an Entrepreneur/s	1	-	-	01	Assessment by Mentor	FEP	100	Min 50
	ED -414	Online Course in Advanced Technology (domain area)	-	-	-	04		FET	100	Min 50
		Total	**10**	**-**	**06**	**20**	Total Hrs: **16**, Total Credits: **20**			

Note

Note Students are required to spend entire semester VIII in preparing DPR and the DPR will be evaluated by a competent Bank authority/Chartered accountant for feasibility individually in the company where the students is doing his internship.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-402: Product/Service Identification and Feasibility

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Pass
3	-	-	3	Theory (100)	FET	20	40
					CAT-1	15	
					CAT-2	15	
					ESE	50	40

Prerequisite: General knowledge of economics & clear concept about own business model.

Course description:
To improve and update knowledge of new entrepreneurs in the area of project preparation and appraisal techniques: decision-making process in the sector of industrial. Infrastructure & sustainable opportunities that would lead to improved viability. Returns and effective investment decision. Writing a business plan which can gain interest of the fund providers like venture capitalists and other source of funding.

Course Outcomes:
After successful completion of the course students will be able to.
CO1: Prepare business Plan for selected business.
CO2: Make risk analysis & Market analysis of selected project.
CO3: Make technical appraisal of selected project.
CO4: Make financial appraisal of selected project.

Unit No.	Course Description	Hrs.
1.	**Project appraisal Introduction:** Project Development Cycle. Identifying data requirement and analyzing their suitability for preparation feasibility studies. Project formulation, screening for pre-feasibility studies. Stages of feasibility report preparation. Project analysis including market Analysis. Technical Analysis & Financial Analysis. Applying various techniques and integrating the data gathered into a full-fledged business plan.	06
2.	**Project Analysis:** Environmental Analysis. Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk Analysis, Quantitative risk Analysis, Risk planning, Risk control, Evaluating the rewards & risk for sustainable opportunities. National cost-Benefit Analysis, Financing Sustainable opportunities.	06
3.	**Business plan:** What is business plan, Entrepreneurial opportunities and business plan. Preparing business plan, (Practical Exercises on preparation of business plan) Components of business plan. Executive summary. Other components, Project report contents.	06
4.	**Commercial Appraisal:** Economic feasibility and commercial viability. Market analysis, Market research, Industry analysis, Competitors analysis, defining the target market, market segmentation, market	06

positioning, building a marketing plan, market strategy.

5.	**Technical Appraisal:** Operation and production plan: Type of production systems, Product design and analysis, New product development, location and layout decision, project layout, plant and technologies choices, product specification and customer needs, production planning and controls, Commercializing Technologies.	06
6.	**Financial Appraisal:** Pro forma income systems, financial projections, Working capital requirement, funds flow and cash flow statements. Ratio analysis.	06

Reference Books

1. Dwivedi, A.K., Industrial project and Entrepreneurship Development,Vikas publishing house.
2. Bangs Jr., D.H., The business planning guide, Dearborn publishing Co.
3. Katz, J.A. and green, R.P., Entrepreneurial Small business, McGraw Hill.
4. Mullins, J. and Komisar R., Getting to plan B, Harvard business press.
5. O'Donnell, M., The businesses plan: Step by Step, UND Center for innovation.
6. Scarborough, N.M. and Zimmerer, T.W., Effective small business management, pearson.
7. Pckle, H.B. and Abrahamson, R.L, Small business management, Wiley.
8. Desai,V., Dynamics of Entrepreneurial Development & management, Himalaya publishing.
9. Kao,j., Creativity and Entrepreneurship, Prentice Hall.
10. Singh, Narendra, Project Management & control, Himalaya publishing.

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-404: Techno Economic Feasibility of Identified Venture &Detailed Project Report (DPR)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	12	6	Assessment by Professionals/ Agencies	FEP	50	50
					ESE	50	

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Description:
Student will prepare technically feasible and economically viable detailed project report including market survey.

Course Outcomes : After successful completion of this course, students will be able to,
CO1: Apply the knowledge of engineering, finance and marketing to formulate a business plan for the new venture.
CO2: Illustrate the requirements for a detailed project report.

Students will work on collection of data required for business plan. Student is required to visit related industries, government organizations, regulatory authorities, raw material vendors bankers and financing institutions related to their business idea. For this student will need to take prior permission of the IEDC/mentor. Student will work independently with the guidance of the IEDC/Mentors/experts in view of implementing his business idea.

Complete record of the student's efforts and systematic execution work will be maintained and guided by the mentor.

At the end of the semester student will submit a Techno economic detailed project report for approving and financing agencies and present the same. The report and the presentation will be evaluated by expert committee recommended by IEDC and approved by COE.

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-406 : Marketing for Entrepreneurship

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Pass %
2	-	-	2	Theory (100)	FET	20	40
					CAT	30	
					ESE	50	40

Course Description-
To familiarize the students with the marketing function & concept of marketing mix & study the marketing mix of some start-ups. Companies operation in India. This course will give overall understanding of marketing management **which** will help them in developing then own marketing decision & in understanding the importance of market survey techniques. It will also help them in conducting suitable market survey for then own selected products.

Prerequisite: General knowledge of market, sales, distribution & advertising & clear concept about own business model.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
CO1: Describe basic principles of marketing for various products.
CO2: Illustrate types of Market survey methods.
CO3: Perform a market survey by applying techniques learned for the selected business.

Unit No.	Course Description	Hrs.
1.	**Introduction (Nature & Scope of Marketing):** Evolution, core-marketing concept, selling concept, marketing concept, Holistic marketing concept, portfolio approach-BCG matrix.	04
2.	**Marketing Environment:** Demographic, economic, political, legal, social, cultural, technological environment (Indian Context): environmental scanning to discover marketing opportunities, Segmentation, Targeting and Positioning difference between segmentation, targeting & positioning, customer value proposition.	04
3.	**Marketing Research:** Concept & practice, steps in Marketing Research, Assessment of demand & supply, Preparation of survey questionnaire.	04

4.	**Product Decision:** Concept of PLC, product classification, product line decision, product mix decision, new product development, branding decision, packaging & labelling, Service as a part of product. **Pricing Decisions:** Determinants of price, pricing method (non-mathematical treatment). Adapting Price (Geographical pricing, promotional pricing & differential pricing), pricing strategies for start-ups.	04
5.	**Promotion Mix:** Factors determining promotion mix, promotional tools basics of advertisement, sales promotion, public relation & publicity & Personal selling. Place (Marketing channels): Channel function, channel level, types of intermediaries (types of retailers, types of wholesalers).	04
6.	**Digital Marketing:** Digital Marketing Overview, Seven "C" of digital marketing, Digital marketing vs e-marketing, Search Engine Optimization (SEO), Social Media Optimization(SMO), Pay per click (PPC), Email Marketing.	04

Reference Books

1. For B2C= Kolter,P.,Keller, K.L., Koshy, A, and Jha, Marketing Management Person.
2. For B2B= Sarin, S.: Strategic Brand Management for B2B Markets, Sage.
3. Kotler P. & Armstrong, G., Principals of Marketing, Person.
4. Amico, Z.D., Marketing, Cengage.
5. Boone, L.E. and Kurtz, D.L., Principles of Marketing, Thomson South-Western.
6. Hoffman, K.D. & Bateson, J.E.G., Marketing of services, Cengage.
7. EDP Resource material by EDI, Ahemadabad.

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-408 : Finance for Entrepreneurship

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Pass %
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description-
This course aims to familiarize students with accounting, mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.

Students will study the financing of small and medium sized businesses from the perspective of both the entrepreneur and investors. They will learn how the financing decisions of small and medium sized private companies differ from those of public firms. They will also see how the use of real option and milestones relate to the strategy and the value on an opportunity.

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
CO1: Describe basic principles of financing methods.
CO2: Analyze financial statements of various businesses.
CO3: Calculate working capital requirement.
CO4: Perform Breakeven analysis for a business model.
CO5: Prepare a financial plan for a selected business/venture.

Unit No.	Course Description	Hrs.
1	**Accounting Terminologies:** Meaning, nature, functions, types of accounting: basic of financial statements, g enerally accepted accounting concepts, principles and conventions: double entry system. Accounting records: Fundamentals of record keeping .the accounting process, transactional analysis, the Adjusting and closing process. Accounting systems, Computer-based accounting systems, Accounting cycle.	03
2	**Financial Statements:** Balance sheet: Assets, liabilities, income statement: concept of income, concept of expenses, concept of gain and losses: Components of the income statement. Other concepts of income .cash flow statements: purpose, components, and categories, Preparation of cash flow statements: concept, activities, Accounting and pricing.	03

3	**Financial Statement Analysis:** Business objectives, measuring, rations: Price earnings, profit margin, investment , capital asset intensity working capital measuring, liquidity and solvency Analysis of cash flow statements break-even analysis, CVP analysis. Full Cost: Cost concepts, direct and indirect costs, product costing systems, non-manufacturing costs, cost analysis, product pricing.	04
4	**The concept of Financial management:** Definition nature, objectives, functions and scope of financial management, Preparation of financial plan its objectives, essential features, consideration in formulating financial plan. Capitalization: Over, under and fair capitalization concept of risk and returns, time value of money.	04
5	**Investment Decisions: Capital budgeting techniques**. Financing Decisions: Cost of capital-meaning definition, classification and computation of specific weighted and marginal cost of capital, capital structure-definition, factors determining the financial structure, leverage Analysis _ financial operating and combined leverages. Dividend decisions: Dividend policy, Dividend theories, Factors affecting dividend decisions, Long term financing, Sources of long-term financing.	04
6	**Working capital management:** Concept of working capital Classification, importance. Factors determining adequate value of working capital. Estimation of working capital requirements. Financing of working capital-Long_ medium_ short term. Trends in Financing of working capital by banks, inventory management. Cash management and Receivable management.	06

References:

1. Maheshwari.S.N. And Maheshwari, S.K., Financial Accounting,Vikas Publishing House
2. Leach.C.J and Melicher. R.W: Entrepreneurial Finance, Thomson.
3. Ghosh.T.P, Financial Accounting for Managers, Taxmann Allied Services
4. Balawani.N., Accounting and Finance for Managers,Excel Books
5. Gupta.A.,Financial Accounting for Management.Prentice Hall
6. bhattacharyya.A.K., Financial Accounting for Business Managers.PH1 Publishing.
7. jain.S.P. And Narang. K.L., Advanced Accountancy,kalyam Publishing.
8. Stanton.J.M.,Entrepreneurial Finance-for new and Emerging Businesses. Thomson
9. Smith.J.K. Smith.R.L and Bliss. R.T., Entrepreneurial Finance. Stanford University

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-410 : Training in EDP Program

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	-	1	Certificate	FET	100	50

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Description:
Student will attend a short-term exclusive Entrepreneurship Development Program (EDP) organized by the university or by any authorized agency approved by IEDC. The Course duration can be one to two weeks.

Course Outcomes : After successful completion of this course, students will be able to,
CO1: Apply the knowledge of engineering, finance and marketing to formulate a business plan for the new venture.
CO2: Illustrate the requirements for a detailed project report.

Students will undergo training programs organized or approved by IEDC and submit the certificate of successful completion of the program.

Programs on marketing, finance management, project report presentation by professional and government agencies. Students are required to apply this knowledge for preparing final project report.

B.Tech Semester - VIII (All Programs)
TRACK – II : Entrepreneurship Venture Stream (EVS)

ED-412 : Mentoring and Guidance by an Entrepreneur/s

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	-	1	Assessment by Mentor	FEP	100	50

An expert from the related domain or an entrepreneur will be assigned as a mentor to individual student to guide and support the student throughout his journey from idea to business plan.

Mentor will observe, review and keep complete record of the student's efforts and systematic execution will evaluate time to time and award a credit after successful completion of the assigned work.

B.Tech Semester - VIII (All Programs)

TRACK – III : Undergraduate Research Opportunity Program (UROP)

	Undergraduate Research Opportunity Scheme - UROP									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
III	RE-402	Research Methodology	3	1	-	04	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	RE-404	Research Project	-	-	12	06	Project	FEP	50	Min 50
								POE	50	
	RE-406	Research Elective	3	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	RE-408	Research Laboratory (As per Elective)			2	01	Practical	FEP	100	Min 50
	RE-410	Research Outcomes (Patents, Publications, Presentations)	-	-	-	02	Outcomes	FET	100	Min 50
	RE -412	Online Course in Advanced Technology (domain area)	-	-	-	04		FET	100	Min 50
		Total	**06**	**01**	**14**	**20**	Total Hrs: **21**, Total Credits: **20**			

Note

Students are required to spend minimum 12 hours on research project under the instructions from supervisor as per the time table.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

RE-402 : Research Methodology

Teaching Scheme				Evaluation Scheme		
L	T	P	Credits	Scheme	Theory (%)	
					WT %	Min % for passing
3	1	-	4	CAT 1	15	50
				CAT 2	15	
				FET	20	
				ESE	50	

Course Description

This course is designed help students develop the research skills required to competently undertake and complete research projects. It will provide students with the training required to develop the skills to review and critically analyze literature on topics related to their research projects, justify the rationale for research, develop effective research designs for their projects, understand the role of theories in research, and learn to wr ite research proposals. Students will acquire skills in both qualitative and quantitative research techniques and learn to report research findings (empirical work) with implications and draw conclusions.

Prerequisites Basic knowledge of statistics.

Course Outcomes

After completion of this course, students will be able to,

1. Select the literature in the chosen area, analyze and interpret research evidence published on a topic to establish a suitable research problem / issue or opportunity to explore further;
2. Design the research study using a suitable paradigm, associated methodologies and methods of data collection and analysis.
3. Write a research proposal (research blueprint) describing the topic.
4. Demonstrate the ability to use the statistical software to process the data to get meaningful conclusion

Unit No.	Detail Content	Hrs.
1	Overview of research Definition of research and characteristics of research; Types of research; Research Process, Preparing a research design, Problem Identification Problem definition, Models used in research.	4
2	Literature survey Importance of literature review, types of literature review, selection of the review topic, searching for the literature, analyzing and synthesizing the literature, writing the review re port	4
3	Data Analysis using Statistical tools, Hypothesis Formulation and testing, Analysis of variance, regression analysis, Response surface methods for process optimization, SPSS/MINITAB software	8
4	Creativity in Research, report preparation with Latex and white smoke, Group discussion on Ethics in Research, Plagiarism check	6
5	Design of experiments Strategy of experimentation, Statistical design of experiments, replication randomization and blocking. Guidelines for designing experiments, Factorial designs. Factorial designs. The two-factor factorial design, Statistical analysis of factorial design, Taguchi design	8
6	Intellectual Property Rights Introduction to IPR; Overview & importance; IPR in India and IPR abroad; Patents; What can be patented, process their definition; granting; infringement, searching & filing: Utility Models an introduction: Copyrights; their definition; granting infringement; searching & filing. Trademarks, role in business, importance, protection, registration;	6

Tutorials

Tutorials are to be designed to work on the statistical packages and also design and analysis of experiments. Students should learn to make reports in Latex.

Reference Books

1. Kothari C. K (2004)2/e, Research Methodology - Methods and Techniques (New Age International, New Delhi).
2. Krishnaswamy, K.N., Shivkumar, Appa Iyer and Mathiranjan M. (2006) Management Research Methodology: Integration of Principles, Methods and techniques (Pearson Education, New Delhi)
3. Douglas C. Montgomery, Design and analysis of experiments, John Wiley and Sons, New York.
4. Tapan Bagchi, Taguchi Methods Explained: Practical steps to robust design, Prentice Hall.
5. Ajit Parulekar and Sarita D'Souza, Indian patents Law- Legal & Business Implications: Macmillan India Ltd., 2006
6. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010

B.Tech Semester - VIII (All Programs)
Track - III : Undergraduate Research Opportunity Phase 2

RE-404 : Research Project

Teaching Scheme				Evaluation Scheme		
L	T	P	Credits	Scheme	Theory (%)	
					WT %	Min % for passing
-	-	12	06	FET	50	50
				ESE	50	50

Course Description

Research Project course aims to develop research skills in UG students. The acquired skills shall be useful to pursue higher level research at M. Tech/M. S or Ph. D level. This course may also help students to get admission in reputed foreign universities for M. S. program as research project completed at UG is one of the selection criteria.

Course Objectives:

After completion of this course, the student will be able to

1. Identify and define research problem.
2. Understand and critically evaluate theories, practices, and / or research on a chosen topic by conducting a thorough literature review and submitting a written integrative, critical summary of the current literature.
3. Approach a research problem and develop a methodology.
4. Perform searches for relevant information.
5. Develop and implement solution to the research problem defined.
6. Develop the ability to explain the conceptual viability of the project and describe the major components involved.
7. Develop the ability to explain how the project will impact the relevant body of work.
8. Develop advanced discipline-relevant skills and competencies.
9. Properly keep an accurate record of research performed.
10. Write a research report and technical paper.

Guidelines

1. Students opting URE module must finalize research advisor, area of research and research project in Vil semester of UG program.
2. Credit Hours: Students are expected to devote 12 hours a week in research project. Students should carefully discuss with their research advisor the time expectations for completion of the requirements research project.

Assessment:

FET Component: Research advisor is encouraged to strongly consider the following grading rubric:

Degree to which students meet expectations. Expectations are to be established by the research advisor and student a minimum of one semester in advance of the student's enrollment in the research course. The follo wing is a minimum set of expectations for every student enrolled in this course for credit: i) perform a background literature search and review, i) develop a project plan, i) perform experimental work or applied experimental work, iv) write and present a research report. All four of these minimum expectations as well as additional expectations (e.g. attendance at departmental and/or college, research seminars, participation in research group meeting, etc) are to be clearly established and articulated to the student by the research advisor prior to commencement of the research project.

Quality of the final report and oral presentation. The research advisor will provide clear expectations of the desired format, content, and deadlines of the final report. The research advisors and DPC will jointly grade the final report.

Attendance.

In order to provide the students a measure of performance, the research advisor is expected to complete a mid -term evaluation of the student, accompanied by recommendations for Improvement for the remainder of the term. The mid-term evaluation of the student should be accompanied by a one-on-one meeting between the research advisor and the student. Student is required to report his/her research advisor every week and brief about the work done for that week. Maintain separate diary for that purpose.

Absences and Make-up Work: Requirements for attendance is as per University norms.

ESE

1. End semester evaluation on all aspects (Scheduled before the end of term dates as notified by DPC)
2. A project report on the activity in prescribed format is to be submitted for evaluation.
3. A technical paper based on research work must be submitted on or before ESE to suitable journal.

B. Tech Semester - VIII (All Programs)

Track - III : Undergraduate Research Opportunity Phase II

RE-406 : Research Elective

Teaching Scheme				Evaluation Scheme			
L	T	P	Credits	Scheme	Theory (%)		
					WT %	Min % for passing	
3	-	-	3	CAT 1	15	40	40
				CAT 2	15		
				FET	20		
				ESE	50	40	

Course Description

Students enrolled in Undergraduate Research opportunity Program Phase l must select a course at UG or PG level which is relevant to his/her research project. The selected course preferably should have lab course associated with i t. Examination scheme of the course and evaluation will be done as per the academic regulations of the institute. In case if relevant course is not offered in the department then research advisor is required to design the course content.

Course Objective

After completion of Research Elective 1 student should be able to develop fundamental knowledge, required to pursue selected research project and understand the concepts principles and application.

Guidelines / Criteria for selecting Research elective 1;

1. Student must finalize research advisor in the VII semester of UG Program.
2. Research project area must be identified in the VII semester.
3. Based on research project area identified, student must decide Research Elective course in consultation with research advisor.
4. Research elective I course selected by students must be related to area of research project. Student can opt for M. Tech course if offered
5. If course offered at PG level has less no of credits, then credits will be matched to 4

B.Tech Semester - VIII (All Programs)

Track - III : Undergraduate Research Opportunity Phase II

RE-408 : Research Elective Laboratory

Teaching Scheme				Evaluation Scheme		
L	T	P	Credits	Scheme	Theory (%)	
					WT %	Min % for passing
-	-	-	06	FEP	50	50
				ESE	50	50

Course Description

Research Laboratory is related to Research Elective I. Examination scheme of the course and evaluation will be done as per rules of University. Student must choose research Elective - 1 course which has laboratory course associated with it. In case if relevant lab course is not available to the Research Elective I, then research advisor shall assign practical work in line with research area. Type of this work may be testing, analysis, measurement, Programming etc,

Course Outcomes:

After completion of Research Laboratory (Elective 1) student should be able to Gain the practical knowledge required to pursue selected research project.

Assessment:

FEP: Evaluation is to be done based on regular work done and performance in the laboratory/field work
ESE: ESE must be conducted jointly by research advisor and one DPC member based on Lab report on the activity is to be prepared and submitted for evaluation

B.Tech Semester - VIII (All Programs)

Track - III : Undergraduate Research Opportunity Phase II

RE-410 : Research Outcomes (Patents and Publications)

The outcome of the Undergraduate Research Opportunity Phase Il is measured with the help of

1. Patents provisionally registered based on outcome of research.
2. Publication of research in refereed Journal
3. . Presenting the paper in reputed conferences at national or International level
4. Writing a working paper based on research undertaken

Evaluation

Grading Rubrics with measurement criteria are designed for grading purpose. Student will earn credits at minimum level i.e. 50% is declared as completed the UROP Track Requirement.

Semester – VIII
B Tech (Mechanical Engineering) Semester - VIII

TRACK – IV : Capstone Project with Program Verticals & University Open Electives

	Capstone Project (with Program Verticals & University Open Electives)									
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
IV	MET-419.X	Programme Elective – V (as per Vertical)	03	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	
	UE-402.X	University Open Elective I	03	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	UE-404.X	University Open Elective II	02	-	-	02	Theory	FET	20	Min 40
								CAT 1	30	
								ESE	50	Min 40
	CP-402	Capstone Project	-	-	12	06	Project	ISE	50	Min 50
								ESE	50	
	CP-404	Career Planning & Corporate Readiness Program	-	-	-	02	Student Portfolio Grading	FET	100	Min 50
	CP-406	Online Course in Advanced Technology(domain area)	-	-	-	04		FET	100	Min 50
		Total	**08**	**-**	**16**	**20**	Total Hrs: **24**, Total Credits: **16**			

Note

Students are required to spend minimum 12 hours on project under the instructions from supervisor as per the time table.

Course Codes : MET – Mechanical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

MET-419.X Programme Elective – V

Semester – VIII		
Programme Verticals	**Course Code** MET 419.X	**Programme Elective – V Courses** (select as per respective Vertical)
Design & Analysis	MET 419.1	Process Equipment Design
Manufacturing Technology & Management	MET 419.2	World Class Manufacturing
HVAC	MET 419.3	Heating, Ventilation & Air Conditioning
Automotive Technology	MET 419.4	Vehicle Dynamics

UE-402.X : University Open Elective – I

	Course Code UE-402.X	**University Open Elective – I (03 Credit Course)**
University Open Elective – I	UE-402.1	Engineering Management
	UE-402.2	Marketing for Engineers
	UE-402.3	Finance for Engineers
	UE-402.4	AI and ML Fundamentals
	UE-402.5	Project Management
	UE-402.6	Electrical Vehicles
	UE-402.7	Optimization Techniques

UE-404.X : University Open Elective – II

	Course Code UE-404.X	**University Open Elective – II (02 Credit Course)**
University Open Elective – II	UE-404.1	Design Thinking
	UE-404.2	Creativity and Innovation
	UE-404.3	Total Quality Management
	UE-404.4	Industry 4.0
	UE-404.5	Costing & cost Control
	UE-404.6	Autotronics
	UE-404.7	Sensor Technology
	UE-404.8	Nano Technology
	UE-404.9	Leadership
	UE-404.10	Entrepreneurship Development
	UE-404.11	Human values & professional ethics

B. Tech. Mechanical Engineering
Final Year (Semester – VIII)

		T	T	C
MET 419.1	**Process Equipment Design**	03	--	03

Course Description

The course goes deeper into the various aspects of mechanical design in the chemical process plant. It stresses upon the design and analysis of the basic process equipment viz. vessels, distillation column, absorption column, heat exchanger, driers and evaporators etc.
The course emphasizes on the development of design skills among the students to take design related decisions. Whatever be the earlier conception, today an engineer is expected to be able to make complete design of a piece of process equipment. A number of problems will be solved to illustrate the concepts clearly.

Pre-requisites MET-401 Design of Power Transmission Elements,
MET-409.1 Design of Mechanical Systems

Course Objectives

This course focuses on the basic concept and criteria for the design of process equipment. Students are able to deal with design referring the relevant codes and standards wherever required.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 419.1.1	Outline basics of process equipment design and important parameters of equipment design	3
CO 419.1.2	Design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads).	3
CO 419.1.3	Determine power requirement for agitator pressure vessel.	3
CO 419.1.4	Design Self supported conical roof and structured supported conical roof	4
CO 419.1.5	Design heat exchanger and equipment accessories	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100	--	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 419.1.1	1		1											
CO 419.1.2		2	1											
CO 419.1.3		2	3											
CO 419.1.4		2	3			2								
CO 419.1.5		2	3											2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 419.1	**Process Equipment Design**	
	Course Content	Hrs
Unit 01 CO 419.1.1	**Introduction** Concept of internal & external design pressure, design stress & design temperature, Different types of equipment, Static & rotary equipment, Different types of static equipment, Various mechanical properties of material, Different methods of fabrication, Different types of welding joints, Joint efficiency, Radiography.	06
Unit 02 CO 419.1.2	**Mechanical design of Pressure vessel** Introduction of ASME Code sec-VIII, DIV-I & IS-2825, Classification of pressure vessel as per IS-2825,Mechanical design of Shell: shell subjected to internal pressure, Different types of head, their selection criteria, Mechanical design of heads: Heads subjected to internal pressure, Different types of Nozzles, their selection criteria, Design of nozzle pipe, Design of reinforcement pad by area for area method	08
Unit 03 CO 419.1.3	**Mechanical design of Reaction Vessel** Mechanical design of shell, head, Jacket, coil, agitator, nozzle, body flange, etc., Different types of agitators & their selection criteria, Different types of agitator shaft sealing system & their selection criteria, Different types of power transmission system, Determination of power required for agitation, shaft diameter, blade thickness, etc., Different types of jackets & their selection criteria, Selection between coil & jacket.	06
Unit 04 CO 419.1.4	**Mechanical design of Storage Tank** Classification of storage tank as per IS-803, Capacity of storage tank, its diameter & height, Design of shell and bottom plate for storage tank, Design of Self supported conical roof, Design of structured supported conical roof as per API 620, Selection of column, girders and rafters, Roof curb angel, Floating roof.	08
Unit 05 CO 419.1.5	**Mechanical design of Shell & Tube Heat Exchangers** Mechanical design of Shell, tube, tube sheet, head, channel shell, , etc. of shell & tube heat exchanger	06
Unit 06 CO 419.1.6	**Supports** Different types of supports, Mechanical design of bracket support, skirt, support & saddle support.	06

MET 419.1 **Process Equipment Design**

Reference Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Process Equipment Design	M.V.Joshi & V V Mahajani	Third edition.	
02	Process Equipment Design (Mechanical Aspects)	By B.C.Bhattacharya	CRC Press	v. 60, 2002
03	Process Equipment Design - Vessel Design	L.E. Brownell & E.H.Young, Frist Edicit		
04	Illustrated Process Equipment Design	S B Thakore	McGraw-Hill Professional	1998
05	Product Design for Manufacture and Assembly	S B Thakore	Second edition	Third Edition, (2010)

B. Tech. Mechanical Engineering
Final Year (Semester – VIII)

		T	T	C
MET 419.2	**World Class Manufacturing**	03	--	**03**

Course Description

Manufacturing has evolved considerably since the advent of industries revolution. In current global and competitive age, it is very important for organization to have manufacturing practice which is lean, efficient, cost-effective and flexible. world class manufacturing is collection of concepts, which set standard for production and manufacturing for another organization to follow. Japanese manufacturing is credited with pioneer in concept of world class manufacturing. world class manufacturing was manufacturing was introduced in the automobile, electronic and steel industry.

World class manufacturing is a process driven approach where various techniques and philosophy are used in one combination or other. Keeping the importance of world class manufacturing in mind a course is offered to the students of Final year B. Tech. Mechanical. This course covers use of various techniques such as TQM, Lean Manufacturing, Benchmarking, JIT, Continuous Improvement, Total preventive maintenance, six sigma, Agile manufacturing which can lead to the industries to world class.

Pre-requisites MET 409.2 Industrial Engineering & Management

Course Objectives

1 To familiarize the students with the concepts of Business excellence and competitiveness.
2 To apprise with the need to meet the business challenges and for being ready to meet the future manufacturing competition.
3 To acquaint with the current manufacturing scenario and the need to move from a domestic to a world class global manufacturer status.

Course Outcomes *Students will be able to*		Bloom's Level
CO 419.2.1	Describe relevance and basics of world class manufacturing.	
CO 419.2.	Relate factors of competitiveness and performance measures, based on which global manufacturing success is bench marked.	2
CO 419.2.3	Suggest different systems and tools for world class manufacturing.	
CO 419.2.4	Decide the role of human resources in world class manufacturing strategy formulation.	4
CO 419.2.5	Develop strategy to achieve world class manufacturing status.	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100	--	--

MET 419.2	World Class Manufacturing

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 419.2.1	3													
CO 419.2.2	2					1								
CO 419.2.3	2													1
CO 419.2.4	2													
CO 419.2.5	2		1											
	(1 – Low, 2 – Moderate, 3 – High)													

	Course Content	Hrs
Unit 01	**Historical Perspective** World class organizations: Meaning of world class. Competitiveness and Performance measures. Criteria for world class organizations in Manufacturing. Competing in World markets. Review of frameworks in World Class Manufacturing (WCM). Models for manufacturing excellence: Schonberger, Halls, Gunn & Maskell models and Business Excellence.	06
Unit 02	**Benchmark, Bottlenecks and Best Practices** Concepts of benchmarking, Bottleneck & best practices. Best performers, gaining competitive edge through world class manufacturing, Value added manufacturing, Value Stream mapping, Eliminating different types of waste. Lean Thinking (Toyota Production System), Six Sigma, Theory of Constraints.	06
Unit 03	**System and Tools for World Class Manufacturing** Improving Product & Process Design: SQC, Statistical Process Control, Quality Function Deployment (QFD), Seven Basic Quality Tools, FMS, Poka Yoke, 5-S, Optimizing Procurement & stores practices, Total Productive maintenance and Visual Control.	06
Unit 04	**Change Management** Organizational Change Management, Process-based Change Models of Organizational Change, Communicating Change, Process of Change Management, Phases of the Change Management Process, Change Management Process Control, Resistance to Change, Overcoming the Resistance to Change, Techniques to Overcome Resistance Strategies for Implementing Change, Factors Affecting the Choice of a Change Strategy, Formulating and Facilitating Change, Implementing Change, Maintaining Organizational Effectiveness, Measurement and Methods of Evaluating Organizational Change.	06

Unit 05	**Characteristics of WCM Companies** Performance indicators like POP, TOPP and AMBITE systems. Other features of WCM: Supply Chain Management & key issues in SCM, Agile Manufacturing, Green Manufacturing, Role of Information system in WCM, Introduction to Knowledge management, Study of various performance measures in world class organization.	06
Unit 06	**Total Quality Management (TQM)** Definition, Understanding quality, Evolution of TQM, Framework for TQM, Commitment and leadership, Customer satisfaction, Employee involvement, Continuous process improvement, Supplier partnership, Performance measures, Formulation and implementation of TQM: Case Study.	06

Reference Books

Sr. No.	*Title of Book*	*Author*	*Publisher/Edition*
1	World Class Manufacturing – Strategic Perspective	Sahay B.S., Saxena K B C and Ashish Kumar	Publications, New Delhi. Mac Milan
2	World Class Manufacturing - The Lesson of Simplicity	Schonberger R. J	Free Press, 1986
3	Management strategy: achieving sustained competitive advantage	Marcus, A. A	New York: McGraw-Hill/Irwin, 2011
4	Manufacturing Strategy: Process and Content	Voss C. A.,	Chapman &Hall, London, 1992
5	Lean production simplified	Pascal. D.	2nd Edition Productivity Press, 2007
6	Total Quality Management	Besterfield, D. H.	Pearson Education, 1999
7	Advanced Operations Management,	Mohanty R. P., Deshmukh S. G.	Pearson Education,2003
8	Managing Technology and Innovation for Competitive Advantage	Narayanan V.K	Prentice Hall, 2000
9	Making Common Sense Common Practice – Models for manufacturing Excellence	Ron Moore, Butter worth Heinmann.	
10	The Toyota Way – 14 Management Principles	Jeffrey K.Liker	Mc-Graw Hill, 2003
11	Operations Management for Competitive Advantage	Chase Richard B., Jacob Robert.	11th Edition, McGraw Hill Publications, 2005

B. Tech. Mechanical Engineering
Final Year (Semester – VIII)

		L	T	C
MET 419.3	**Heating Ventilation and Air Conditioning**	03	--	**03**

Course Description

This Course provides a simple understanding of Refrigeration and Air-conditioning fundamentals. The course consists of different refrigeration cycles and understanding of psychrometry and psychrometric processes used for the purpose of air-conditioning. Further, the comfort air-conditioning and indoor environment health are also addressed in this course.

Pre-requisites

MET-207 Thermodynamics, MET-307 Heat & Mass Transfer, MET-403 Refrigeration and Air Conditioning

Course Objectives

1 To gain the knowledge of various psychrometric processes.
2 To understand different ventilation systems and their designing concept.
3 Estimation of outdoor and indoor air conditioning system requirement as per the need of human comfort.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 419.3.1	Describe the fundamentals of Psychrometry	02
CO 419.3.2	Apply human comfort indices and comfort chart to design indoor conditions of HVAC systems.	03
CO 419.3.3	Estimate heating and cooling loads for buildings according to ASHRAE Procedures /standards.	04
CO 419.3.4	Design and evaluate complete air distribution system including fan, duct, and Installation requirements for a typical HVAC system.	04
CO 419.3.5	Explain different components of ventilation systems.	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100	--	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 419.3.1	2	2												
CO 419.3.2		3												
CO 419.3.3		3		3										
CO 419.3.4			3											
CO 419.3.5	2													
	(1 – Low, 2 – Moderate, 3 – High)													

MET 419.3 Heating Ventilation and Air Conditioning

	Course Content	Hrs
Unit 01	**Introduction to HVAC system**: HVAC definition, history of HVAC, HVAC systems and its classifications, applications of HCAC system.	06
Unit 02	**Psychrometry and HVAC processes:** Thermodynamic properties of moist air, Important Psychrometry properties, Psychometric chart; Psychrometric process in air conditioning equipment, applied Psychrometry, air conditioning processes, air washers.	07
Unit 03	**Design considerations for HVAC system:** Thermodynamics of human body, metabolic rate, energy balance and models, thermoregulatory mechanism. Comfort & Comfort chart, Effective temperature, Factors governing optimum effective temperature, Design consideration. Selection of outside and inside design conditions.	07
Unit 04	**Heat Transfer Through Building Structures:** Solar radiation; basic concepts, sun-earth relationship, different angles, measurement of solar load, Periodic heat transfer through walls and roofs. Empirical methods to calculate heat transfer through walls and roofs using decrement factor and time lag method. Infiltration, stack effect, wind effect. CLTD/ETD method – Use of tables, Numerical and other methods, Heat transfer through fenestration – Governing equations, SHGF/SC/CLF Tables	07
Unit 05	**Heating and cooling Load Calculation**: Types of air-conditioning systems, General consideration, internal heat gains, system heat gain, cooling and heating load estim ate.	07
Unit 06	**Ventilation System:** Introduction- Fundamentals of good indoor air quality, need for building ventilation, Types of ventilation system, Air Inlet system. Filters heating & cooling equipment, Fans, Duct design, Grills, Diffusers for distribution of air in the work place	06

Reference Books

Sr. No.	*Title of Book*	*Author*	*Publisher/Edition*
01	Principles of Refrigeration	Gosney W.B.,	Cambridge University Press, 1982.
02	Thermal Environmental Engineering	ThrelkeldJ.L	Prentice Hall, New Jersey 1962.
03	Principles of Refrigeration	Dossat, R.J. and Horan, T.J.,	5th Edition, Prentice Hall, 2001
04	Refrigeration & Air conditioning	R.C. Arora	PHI, 2010.
05	ASHRAE Data Book.		

B. Tech. Mechanical Engineering
Final Year (Semester – VIII)

		L	T	C
MET 419.4	**Vehicle Dynamics**	**03**	**--**	**03**

Course Description

The course will cover the dynamics of vehicles on the road during normal operation as well as during impact. Specific topics include acceleration & braking characteristics, steady state handling and ride characteristics. This course deals with mechanics & dynamics of road vehicles.

Pre-requisites

MET303 Dynamics of machines, MET309.4Automobile Engineering

Course Objectives

1 To understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions.
2 To provide an overview of important concepts of road vehicle dynamics.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 419.4.1	Explain the importance of Vehicle Dynamics	1
CO 419.4.2	Identify the effect of different parameters on Performance Characteristics of Road Vehicles	2
CO 419.4.3	Evaluate handling characteristics of a vehicle for a given set of data	3
CO 419.4.4	Compare different vehicle ride models	2
CO 419.4.5	Describe different trends in Vehicle dynamics	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	100	100		

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 419.4.1	1					2								2
CO 419.4.2	1	2										2		2
CO 419.4.3	2	2										2		2
CO 419.4.4	1	2												2
CO 419.4.5	1					2						2		2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 419.4 **Vehicle Dynamics**

Unit No.	Course Contents	Hrs
01	**Introduction** Classification of vibration, Specification and Vibration, Vibration System and human comforts, Introduction to vehicle dynamics, Fundamental approach to modeling- lumped mass, coordinate systems, Newton's second law, Dynamic axle loads.	06
02	**Acceleration Characteristics** Power for propulsion, Traction and Tractive effort, Power limited acceleration - engines, power train, selection of gear ratio, Traction limited acceleration transverse weight shift due to drive torque.	06
03	**Braking Characteristics** Basic Equations (Constant Deceleration, deceleration with wind resistance), Energy/ Power absorbed during braking, Braking Forces, Brake factor, Mechanism of tire-road friction, Federal Requirements for Braking Performance, Brake proportioning, Braking efficiency, Rear wheel lockup, Braking of vehicle - Braking applied to rear wheels, Front wheels and all four wheels, Braking of vehicle moving in a curved path	07
04	**Handling Characteristics** Steady State Handling: Low speed turning, Off tracking, High speed cornering, Neutral steer, Under steer and over steer, Steady state response, Yaw velocity, Lateral Acceleration, Curvature response, jack-knifing in articulated vehicle. Suspension effects on Cornering- Rolling moment distribution, Camber Change, Roll steer, Lateral Force compliance steer, Aligning Torque, Effect of tractive force on Cornering.	07
05	**Ride Characteristics** Excitation sources, Vehicle response properties – suspension isolation, suspension stiffness, suspension damping, wheel hop resonance, Suspension nonlinearities, Rigid body bounce/pitch motions, bounce/pitch frequencies, Tolerance to seat vibrations, Human response to vibrations, vehicle ride models- Two degree freedom model for sprung & unsprung mass, Two degree freedom model for pitch & bounce, roll centre & roll axis. Introduction to random vibrations	07
06	**Recent trends in vehicle dynamics** Stability Control systems, Introduction of vehicle sensors, Central tire inflation systems, Influence of parameters at vehicle rollover, Vehicle dynamics simulations, AMT, CVT, Direct Shift Gear, Electronic stability control, Traction control, Adaptive Cruise control, Semi-active suspension, Anti-squat/anti-dive geometries	07

MET 419.4 **Vehicle Dynamics**

Reference Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Fundamentals of Vehicle Dynamics	Thomas D. Gillespie	Society of Automotive Engineers	2012
02	Theory of Ground Vehicles	J. Y. Wong	John Wiley and Sons Inc., New York	2001
03	Steering, Suspension and Tyres	J.G. Giles	Illiffe Books Ltd	1968
04	Tyre and Vehicle Dynamics, ,	Hans Pacejka	SAE Publications, 2nd edition	2011
05	The Multi body Systems Approach to Vehicle Dynamics	Blundell, M. and Harty, D	Elsevier Publications	2011

UE-402.X : University Open Elective – I

	Course Code	University Open Elective – I (03 Credit Course)
	UE-402.X	
University Open Elective – I	UE-402.1	Engineering Management
	UE-402.2	Marketing for Engineers
	UE-402.3	Finance for Engineers
	UE-402.4	AI and ML Fundamentals
	UE-402.5	Project Management
	UE-402.6	Electric Vehicles
	UE-402.7	Optimization Techniques

B Tech (Common to all Programs) Semester – VIII
Course work with Capston Project
University Open Elective I

UE-402.1 Engineering Management

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:
Engineering management gives overview of business environment the factors affecting the business environment. The effect of global environment on different business activities. It also focuses Business development framework and world class business practices. In its second part it highlights business functions and its integration to make the business profitable. In addition, it gives the guidelines about engineering economics and the different accounting principle used in industry to evaluate business performance

Course Learning Outcomes:
After successful completion of this course, students will be able to
1. Identify the factors that influence business environment.
2. Discus different business growth strategies
3. Justify importance of business excellence models on world class business development
4. Appraise the scope and objectives of functional areas of business and their integration
5. Apply engineering economics for evaluation of business

Course Content

1. Overview of Business Environment (6)

Definition of Engineering Management, Engineering Managers

Business Environment- Nature, scope and objectives of business, National & Global Perspective, Environmental Analysis and Forecasting. Factors Affecting the Business Economic Environment, Political and government Environment, natural and Technological Environment, Business and Society, Industrial Policies and Regulations, Economic planning and Development,

Global Environment- GATT/WTO and Global Liberalization, international Investments, Multinational Corporations, Globalization

2. Business Development Framework (6)

Vision, Mission, Objectives, Goals, Strategic Planning. SWOT Analysis, Policy formation, Procedure, Steps in Development Framework, Roles of Engineering Managers, Decision Making. Organizing. Leading. Engineer as a leader, Engineer as a manager, leadership skills for 21 century, Controlling setting performance standard, benchmarking

3. World Class Business Development (6)

Understanding Business Excellence, Core Values and Concepts, Business Excellence Introduction to Baldrige Model and EFQM Model, Detailed Study and Case Studies on EXIM Bank relationship between Business Excellence Models and Core Values and Business Excellence Assessment, Criterion, Competitiveness) Growth Collaboration, Acquisition, Merger, Joint Ventures

4. Integration of Business Functions (6)

Product Production and Sales Planning. Materials Management Purchasing. Marketing Management, Finance Resource Management, Supply Chain Management, Human Resource Management, Customer Relationship Management, Manufacturing Planning, Inter-relationship of all Business Functions (ERP Modules) Case Studies

5. Engineering Economics (6)

Engineering Economics - Introduction, Cost Analysis, Time value of money and compound interest Cash flows, Annuity, Depreciation, Methods of Computing Depreciation(Sinking Fund Method, Declining Balance Method, Sum of Years Digit Method). Investment decision for capital assets, Evaluation Criterion for Investment Decisions- Payback Period, Average Rate of Return, Net Present Benefit Cost Internal Rate of Return(IRR)

6. Financial Accounting, Analysis & Management (6)

Introduction, Accounting Principles, Types of Accounts, Key Financial Statements, Fundamentals of Financial Analysis, Balance Sheet, Elements of Market Economy, Capital Sources of finance, Financial Institutions, Financial statements, Balance sheet and P&L accounts

Reference Books

1. Dr M. T. Telsang, Industrial Engineering and Production Management, S. Chand & Co.
2. C. M. Chang, Engineering Management, Pearson Education Inc, 2012.
3. J.P. Bose, S. Talukdar, Business Management -, New Central agencies (P) Ltd.
4. Francis Cherunilam, Business Environment, Himalaya Publishing House, 1997.
5. K. Shridhara Bhat, World Class Manufacturing. Himalaya Publishing House, 1"
6. edition, 2013.
7. James A. F. Stoner, R. Edward Freeman, Management, Prentice Hall of India New Delhi, 6 edition, 2009.
8. 4 Gene Burton and Manab Thakur, Management, Today Principles and Practice, Tata McGraw Hill Publishing Company, New Delhi, 1995.
9. Koontz & O'Donnell, Essentials of Management, McGraw-Hill, 10 edition, 2015.
10. Philip Kotler, Marketing Management, Prentice Hall of India New Delhi, 155 edition, 2016.Program Elective-IV MEE2110: Logistics and Supply Chain Management

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective I

UE 402.2 Marketing for Engineers

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description
To familiarize the students with the marketing function & concept of marketing mix & study the marketing mix of some start-ups, companies operating in India. This course will give overall understanding of marketing management which will help them in developing their own marketing decisions & in understanding the importance of market survey techniques. It will also help them in conducting suitable market survey for their own selected products

Course Learning Outcomes:
After successful completion of the course, students will be able to
1. Apply basic principles of marketing for various products,
2. Prepare market survey.
3. Select proper product mix & pricing decision.
4. Select proper digital marketing technique for selected business

Prerequisite:
General knowledge of market, sales, distribution & advertising & clear concept about own business model.

Course Content

1. Introduction to marketing (6)
Evolution; core marketing concept, selling concept, marketing concept, Holistic marketing concept, portfolio approach-BCG matrix; Marketing Environment: Demographic, economic, political, legal, socio cultural, technological environment (Indian context); environmental scanning to discover marketing opportunities

2. Market segmentation & marketing Research (6)
Targeting and Positioning. difference between segmentation, targeting and positioning, customer value proposition. Marketing Research- Concept & practice, Steps in Marketing Research, Assessment of demand & supply, Preparation of survey questionnaire

3. Product Decisions (6)
Concept of PLC, product classification, product line decision, product mix decision, new product development, branding decisions, packaging & labeling, Service as a part of Product

4. Pricing Decisions (6)
Determinants of price, pricing methods (non-mathematical treatment). Adapting Price (Geographical pricing, promotional pricing and differential pricing), pricing strategies for startups

5. Promotion & Place Decisions (6)

Factors determining promotion mix, promotional tools basics of advertisement, sales promotion, public relations & publicity and personal selling.

Distribution Channel functions, channel levels, types of intermediaries (types of retailers, types of wholesalers)

6. Digital Marketing (6)

Digital Marketing Overview, Seven "C" of Digital Marketing. Digital Marketing vs e-marketing, Search Engine Optimization (SEO), Social Media Optimization (SMO). Pay per Click (PPC), Email Marketing

Reference Books

I For B2C , Kotler, P., Keller, KL, Koshy, A and Jha, M.: Marketing Management, Pearson
2. For B2B , Sarin, S.: Strategic Brand Management for B2B Markets, Sage References:
3. Kotler P. & Armstrong, G., Principles of Marketing. Pearson
4. Amico, Z.D., Marketing, Cengage
5. Boone, L.E and Kurtz, D.L Principles of Marketing. Thomson South-Western
6. Hoffman, K.D. and Bateson, J.E.G., Marketing of Services, Cengage
7. EDP Resourse material by EDI. Ahmedabad

B Tech (Common to all Programs) Semester – VIII
Course work with Capston Project
University Open Elective I

UE 402.3 Finance for Engineers

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course description -
To familiarize students with accounting, mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.

The objectives of the course are to build the skills, frameworks and knowledge in finance. Students will study the financing of small and medium sized businesses from the perspective of both the entrepreneur and investors. They will learn how the financing decisions of small and medium sized private companies differ from those of public firms. They will also see how the use of real options and milestones relate to the strategy and the value on an opportunity

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Understand basic Financial Terminologies.
2. Prepare & analyze financial statements.
3. Prepare financial Plan for venture.
4. Make & analyze investment decisions.
5. Calculate working capital requirement

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Content

1. Accounting Terminologies (6)
Meaning, nature, function, types of accounting, basics of financial statements, generally accepted accounting concepts, principles and conventions: double entry system. Accounting Records, Fundamentals of record keeping, the accounting process, transactional analysis, the Adjusting and Closing process. Accounting systems. Computer based accounting systems. Accounting cycle.

2. Financial Statements (6)
Balance sheet: assets, liabilities. Income statement: concept of income, concept of expenses, concept of gain and losses Components of the income statement. Other concepts of income Cash Now statements: purpose, components, and categories. Preparation of cash flow statements concept activities Accounting and pricing.

3. **Financial Statement Analysis** (6)
Business objectives, measures Ratios:Price Earnings, Profit margin, investment, capital asset intensity, working capital measures, liquidity and solvency. Analysis of cash flow statements Break-even analysis, CVP analysis,
Total Cost: cost concepts, direct and indirect costs, product costing systems, non-manufacturing costs, cost analysis, product pricing.

4. **The concept of Financial Management** (6)

Definition, nature, objectives, functions and scope of financial management, Preparation of financial plan its objectives, essential features, consideration in formulating financial plan, Capitalization over, under and fair capitalization. Concept of risk and returns, Time value of money.

5. Investment Decisions (6)

Capital budgeting technique.

Financing Decision Cost of Capital - Meaning, definition classification and computation of specific weight and marginal cost of capital. Capital structure - Definition, factors determining the financial structure, Leverage Analysis - Financial operating and combined leverage.

Dividend decision: Dividend policy, Dividend Theories. Factors affecting dividend decisions. Long term financing. Sources of long term financing

6. **Working Capital Management** (6)

Concept of working capital - Classification, importance, factors determining adequate value of working capital. Estimation of working capital requirements. Financing of working capital - Long- medium-short term. Trends in Financing of working capital by banks, Inventory management. Cash Management and Receivable Management

Reference Books

1. Maheshwari, S.N. and Maheshwari, S.K, Financial Accounting, Vikas Publishing House
2. Leach, CJ. and Melicher, R. W: Entrepreneurial Finance. Thomson.
3. Ghosh, T.P.. Financial Accounting for Managers, Taxmann Allied Services
4. Balwani, N., Accounting and Finance for Managers, Excel Books
5. Gupta, A., Financial Accounting for Management, Prentice Hall
6. 4 Bhattacharyya, A.K., Financial Accounting for Business Managers, PHI Publishing
7. Jain, S.P. and Narang. K.L, Advanced Accountancy, Kalyani Publishers,
8. Stanton, J.M., Entrepreneurial Finance - For New and Emerging Businesses, Thomson
9. Smith, J.L. Smith, R.L. and Bliss, R.T. Entrepreneurial Finance, Stanford University

B. Tech. (All Programs) Semester VIII
Course work with Capston Project
University Open Elective I

UE 402.4 Artificial Intelligence & Machine Learning Fundamentals

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:
This course gives a basic introduction to machine learning (ML) and artificial intelligence (AI). Through an algorithmic approach, the students are given a practical understanding of the methods being taught, in particular through making their own implementations of several of the methods. The course covers supervised classification based on e.g., artificial neural networks (deep learning), as well as unsupervised learning (clustering), regression, optimization (evolutionary algorithms and other search methods). Course gives overview of neural network and deep learning techniques. Number of case studies are expected to be covered to have better understanding of applications of AI and ML.

Course Objectives

The Open elective aims to equip students as follows:

1. Understand different ways of modeling data and real-world scenarios computationally;
2. Be able to model a real-world problem into the appropriate form (such as optimization, classification, regression, clustering, or association);
3. Be able to apply the appropriate artificial intelligence or machine learning techniques to solve the problem;
4. Understand common pitfalls and limitations of existing techniques

Course Learning Outcomes:
After successful completion of the course, students will be able to

1. Discuss[2] the pros and cons for choosing ML & AI methods for different applications
2. Develop[3] problem solving methodology for selected ML & AI methods
3. Use[3] popular AI & ML tools like Python, Tensorflow and Keras to develop applications

Prerequisite:
Probability Distributions, Python Basics

Course Content

UNIT 1: Machine Learning: Introduction
Overview of Machine learning concepts – Types of Machine learning, Supervised learning, Unsupervised learning, Reinforced learning, Data preprocessing techniques

UNIT 2: Machine Learning: Prediction Techniques
Linear Regression, Naive Bayes classifier, K-Nearest Neighbors, Decision trees, Random forest, Clustering - k-means

UNIT 3: Artificial Intelligence: Introduction
Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, agents, environments, Problem solving as state space search, production system, control strategies and problem characteristics; Search techniques: Breadth First and Depth-first, Hill-climbing, Heuristics and Meta-heuristics, Best-First Search

UNIT 4: Artificial Intelligence: Genetic Algorithms and Fuzzy Logic

Genetic algorithms - Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using GAs, Fuzzy logic – introduction, operations, Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzifications & Defuzzifications, Fuzzy Controller

UNIT 5: Artificial Neural Networks and Model Evaluation

Introduction to ANN, Perceptron, Deep Learning – Introduction, convolution neural networks, Deep learning framework – Tensorflow, Model evaluation techniques

UNIT 6: Applications of AI and ML

Use of AI in banking and finance, Fraud detection, AI in manufacturing industry: Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, IoT: Prevention first Predictive analytics, Machine learning in government administration: Type of government problems appropriate for AI applications, AI for Answering questions, Routing requests, Chat bots for communication between citizen and government, Introduction to Smart grid, Machine learning applications in smart grid.

Reference Books

1. www.coursera.com - online course on Machine Learning by Andre NG
2. Artificial Intelligence: A Modern Approach, 3rd edition,Stuart J. Russell and Peter Norvig, Publisher: Pearson
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective I

UE 402.5 Project Management

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description

The course covers key components of project management including project integration, project scope management, project time and cost management, quality management, human resource considerations, communications, risk management, and procurement management.

Student Learning Outcomes: Upon satisfactory completion of the course, the learner should be able to

1. Recognize issues in a realistic project scenario.
2. Employ work breakdown structures (WBS) in a project application.
3. Demonstrate the use of appropriate network scheduling techniques.
4. Produce a project proposal
5. Discuss the implementation of a proposed plan

Course Contents

1. Basics of Project Management (6)
Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

2. **Project Identification, Selection and planning (6)**
Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

3. PERT and CPM (6)
Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts

4. Project Risk Management (6)
Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks, Project Management Information System (PMIS), Planning of PMIS, Design of PMIS

5. Project Performance Measurement and Evaluation (6)
Introduction, Purchase Cycle, Contract Management, Procurement Process, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

6. Project Execution and Control (6)

Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow-up.

Reference Books

1. Cleland, David I. and William R. King, Systems Analysis and Project Management, McGraw-Hill Book Company, New York,
2. Moder, Joseph J. and Cecil R. Phillips, Project Management With CPM and PERT, Van Nostrand-Reinhold Company, New York, (2nd. ed.)
3. Martino, R. L., Project Management and Control in three volumes: "Finding the Critical Path," "Applied Operational Planning," and "Allocating and Scheduling Resources," American Management Association, New York
4. Archibald, Russell D. and Richard L. Villoria, Network Based Management Systems (PERT/CPM), Wiley, New York,
5. Wiest, J. D. and F. K. Levy, A Management Guide to PERT/ CPM, Prentice Hall, Inc., New York,
6. Woodgate, H. S., Planning by Network, Project Planning and Control Using Techniques, Brandon Systems Press, New York,
7. Graham, Robert J., and Randall L. Englund. Creating an Environment for Successful Projects. San Francisco: Jossey-Bass
8. Lewis, James. Team-Based Project Management. Beard Books
9. Lewis, James. Mastering Project Management. New York: McGraw-Hill
10. Lewis, James. The Project Manager's Desk Reference, Third edition. New York: McGraw-Hill

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective I

UE 402.6 Electric Vehicles

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description

This course shall equip the students to avail emerging opportunities in the area of HEV & EV technology in automotive industry. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc.

Pre-requisites

FYT107 Elements of Electrical Engineering

Course Objectives

1 To introduce the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2 To study various energy sources and motor drives for Electric & Hybrid vehicle

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 409.4.1	Identify need of Electric & Hybrid vehicle	1
CO 409.4.2	Design Electric vehicle for given requirement	3
CO 409.4.3	Design Hybrid Electric vehicle for given requirement	3
CO 409.4.4	Elaborate different Energy sources for Electric & Hybrid vehicle	2
CO 409.4.5	Choose suitable motor drive for Electric & Hybrid vehicle	3

01	**Hybrid Vehicles Technology** Hybrid electric drive-train, Classification, operating modes, Various architectures of HEVs, Parallel hybrid drive-train with torque coupling & speed coupling	07
02	**Design of HEVs** Control strategies, Design principle for series hybrid electric drive train, Sizing of elements of series & parallel hybrid electric drive trains	06
03	**Energy Sources and Propulsion** Batteries for EVs & HEVs, Battery Management, Ultra Capacitors, Mechanical flywheel, Electronic devices for EVs & HEVs, Fuel cell concept & characteristics, Fuel cell technology for EVs & HEVs, Hydrogen storage & reforming.	06

04	**Electric Vehicle Motors** Types of Motors, DC Motors, Induction Motor, BLDC Motor, Permanent Magnet Motors – Principle, Construction, Selection & sizing of motors, RPM and Torque calculation of motor, Motor Controller, Motor ratings	07

Reference Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Modern Electric, Hybrid Electric & Fuel cell Vehicles- Fundamentals, Theory & Design	Mehrdad Ehsani, Yimin Gao, Ali Emadi	CRC press, New York,	2010
02	Electric & Hybrid Vehicles- Design Fundamentals	Iqbal Hussain	CRC press, New York	2003
03	Electric & Hybrid Vehicles	Robin Hardy, Iqbal Hussain	CRC press	ISBN 0-8493-1466-6
04	Electric Vehicle Technology Explained	James Larminie, John Lowry,	John Wiley & Sons Ltd. England	2003
05	Electric Vehicle Battery Systems	Sandeep Dhameja	Newness, Massachusetts	2002
06	The electric car: Development & Future of Battery, Hybrid & Fuel- Cell Cars,	Dr Mike Westbrook, M H Westbrook	British library cataloguing in publication Data, UK,	ISBN0852960131

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective I

UE 402.7 Optimization Techniques

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:
This course deals with Fundamental optimization methods, operations research, heuristic optimization techniques, evolutionary or population-based hyperi metaheuristics, parallel optimization techniques. Application of these methods to complex science engineering domains

Course Learning Outcomes
After successful completion of the course, students will be able to

1. Optimize performance of given problem under a set of resource constraints
2. Identify suitable mathematical programming techniques to optimize performance of given problem
3. Apply suitable mathematical programming techniques to optimize performance of given problem under a set of resource constraints where either objective function or set of constraints may be linear or non-linear.
4. Apply artificial intelligence (AI) techniques (meta-heuristics) to improve the efficiency of manufacturing systems.
5.

Prerequisite:
Students with knowledge of basic mathematics and statistics can opt this course.

Course Content

1.Linear Optimization (6)
Simplex Method Revised Simplex Method. Sensitivity Analysis. Duality, and Queuing Theory

2. Nonlinear Optimization **(6)**
Introduction, Lagrange Method, Kuhn-Tucker conditions, Quadratic programming, separable programming, chance constrained programming or stochastic programming

3.Introduction to Integer programming and decision theory **(6)**
Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method. Decision theory, Decision under certainty, Decision under risk, Decision under uncertainty, Decision Tree

4.Introduction to Dynamic Programming **(6)**
Concept of Sub optimization and the principle of optimality: Linear and Continuous Dynamic Programming with Applications in capital budgeting, reliability improvement, cargo loading and minimizing total tardiness in single machine scheduling problem etc.

5.Advanced Optimization Methods-I (6)
Multi-criteria Decision Making, AHP, Meta-heuristic algorithms: Genetic algorithms

6.Advanced Optimization Methods-II **(6)**
Neural networks, Particle Swarm Theory & Ant colony optimization.

Reference Books

1. Rao S.S. Engineering Optimization Theory and Practice, New Age Int. Pub., 3rd Ed., 1996.
2. 2.Haug, E. J. and Arora, J.S., Applied optimal design Wiley Inter Science Publication, NY, 1979
3. Douglas J. Wilde, Globally optimal design John Wiley & Sons, New York, 1978
4. Johnson Ray C., Optimum design of mechanical elements, John Wiley & Sons, 1981.
5. S.D. Sharma, "Operations Research", Khanna Publications, 2001.
6. David Goldberg, Genetic Algorithms, pearson publications, 2006.
7. Gen, M. and R. Cheng, Genetic Algorithms and Engineering Optimization, Wiley Interscience, 1999

UE-404.X : University Open Elective – II

	Course Code UE-404.X	University Open Elective – II (02 Credit Course)
University Open Elective – II	UE-404.1	Design Thinking
	UE-404.2	Total Quality Management
	UE-404.3	Industry 4.0
	UE-404.4	Costing & cost Control
	UE-404.5	Autotronics
	UE-404.6	Sensor Technology
	UE-404.7	Nano Technology
	UE-404.8	Leadership
	UE-404.9	Entrepreneurship Development
	UE-404.10	Human values and Professional Ethics

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective II

UE 404.1 Design Thinking

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

It includes identification of opportunity for development of new product based on requirement of customer. Starting from the generation of concepts and its evaluation, preparation of prototype, Product design and testing all aspects of product design are covered. Emphasis is given of aesthetic and ergonomic consideration in design

Pre-requisites

Engineering Graphics Lab

Course Outcomes

Students will be able to

1. **List** challenges/ problems of customer and specify customer needs
2. **Compare** different ways for Concept selection & testing
3. **Apply** different tools and techniques of product design
4. **Review** aesthetic and ergonomic consideration for design of Product

Course Contents

1. Discovery- Opportunity identification for new products (6)

Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas,. Steps in NPD Product idea generation, creativity and innovation.

Identifying Customer Needs, Voice of the customer, gathering customer needs, organizing and prioritizing needs, Product mission statement, Benchmarking and establishing product specifications

2. Product Concept Generation, Selection and Testing (6)

Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing- Purpose, process and methods. Product Architecture-types, establishing architecture, Modular design. Prototyping

3. Product Design Process and Tools and Techniques (6)

Product Design process steps, Stage gate model, Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering.

4. Design Considerations (6)

Product dimensions, Design for manufacturing and assembly (DFMA), Design for Sustainability, Aesthetic aspects- Symmetry, balance, contrast, continuity, rhythm, Form and styling, Color in product design, Ergonomic considerations, Anthropometry

Reference Books

1. Dr Martand Telsang, Industrial Engineering and Production Management, S. Chand & Co. NewDelhi,2006
2. Ulrich, Eppinger, Anita Goel, Product Design and Development, McGraw Hill Publishing
3. Otto & Wood, Product Design, Pearson Education
4. Seider, Lewin,Widagdo, Product and Process Design Principles: Synthesis, Analysis and Evaluation, Wiley Publication
5. Don Norman, The Design of Everyday Things, Basic Books
6. Michael G. Luchs, Scott Swan, Design Thinking: New Product Development Essentials from the PDMA, Wiley Publication
7. Richard Morris, The Fundamentals of Product Design, Bloomsbury Publishing
8. Cooper, Robert G, Winning at New Products, Basic Books

B.Tech. Semester VIII (All Programs)
Course work with Capston Project
University Open Elective II

UE-404.2 Total Quality Management

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

It gives the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.

Course Outcomes

After successful completion of the course, students will be able to

1. State importance of assuring quality in the service or manufacturing sector and explain Quality assurance system
2. Identify and solve the quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques,
3. Calculate reliability of system
4. Interpret various quality attributes and discuss the various quality approaches. 6. Comment on quality using Taguchi Philosophy.

Course Contents

UNIT I **INTRODUCTION** (6)

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II **TQM PRINCIPLES** (6)

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III **TQM TOOLS AND TECHNIQUES I** (6)

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types., Control Charts - Process Capability - Concepts of Six Sigma

UNIT IV **QUALITY SYSTEMS** (6)

Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sector

Reference Books

1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education
1. (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing
3. House, First Edition 2002.
4. Implementing Juran's Road Map for Quality Leadership: Benchmarks and ResultsBy Al Endres, Wiley, 2000
5. Understanding, Managing and Implementing Quality: Frameworks, Techniques and CasesBy Jiju Antony; David Preece, Routledge, 2002
6. Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000: The CEO ReportBy Edward E. Lawler; Susan Albers Mohrman; George BensonJossey-Bass, 2001
7. Total Quality Control Feigenban - McGraw Hill Book Company, New York 2
8. " Fundamentals of Quality Control and Improvement", Amitava Mitra, Pearson Education.
   Six Sigma Black Belt Handbook – Thomas McCarty, Michael Bramer & Praveen Gupta, Tata McGraw Hill
9. Six Sigma Performance Hardware by Praveen Gupta, Tata McGraw Hill Pub.

B.Tech. Semester VIII (All Programs)
Course work with Capston Project
University Open Elective II

UE-404.3 Industry 4.0

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description
This course provides a comprehensive overview of the role of digitization, big data, cyber-physical manufacturing systems, robots, human robot collaboration, artificial intelligence and all relevant Industry 4.0 technologies. In particular, we focus on applications and case studies in order to make the audience understand the new technologies and demonstrate the benefits of Industry 4.0. We also include contributions from researchers and industry to the opportunities and challenges of Industry 4.0. One of the greatest challenges in upgrading to Industry 4.0 is education, without young academics the transition to Industry 4.0 won't be sustainable.

Course Outcomes
After successful completion of the course, students will be able to
1. State basics, drivers and enablers of Industry 4.0 2
2. Explain modern methods and techniques of planning, dimensioning, design and optimization of Industry 4.0 production systems
3. Identify value chains in Industry 4.0
4. Develop skills in dealing with methods and techniques for various production system

Course Content

1. **Introduction to Industry 4.0 & Basic principles and technologies of a Smart Factory** (6)
Definition of Industry 4., Developments in India, Germany. USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and today's Factory, Difference between conventional automation and Industry 4.0, Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber-Physical Systems, Value chains in manufacturing companies, Customization of products , Digital Twins, Cloud Computing / Cloud Manufacturing, Security issues within Industry 4.0 networks

2. **Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS)** (6)
Definitions, demarcation to embedded systems, ubiquitous computing, etc., Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory and real-time requirements, Self-organization principles, Communication in cyber-physical systems, Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development), Applications for cyber-physical systems

3. **Assistance systems for production** (6)
The connected worker within the Industry 4.0 scenario, Diversity-driven workplaces (barrier free workplaces, accessibility in production), Human-and task-centered assistance systems, Technical tools, Mobile information technologies, Shop floor information systems, Production line support systems (pick by light, assembly display systems, assembly control by vision), Manipulator systems and intelligent chairs, Human work support by using exoskeletons, Applications assistance systems in production

4. **Human-Robot Collaboration, Safety and Security** (6)

Human-Robot Collaboration in Industry, Collaborative Robots, examples Yumi, IIWA, UR, Panda, Types of Human-Robot Collaboration, Applications with Collaborative Robots, Safety with Industry 4.0, Safety for connected Machines and Systems, Safety in Human Robot cooperation, Security & Security Risks with Industry 4.0, Security and privacy risks in AI, Approach to Cyber-Physical Security in Industry 4.0

1. "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist
2. "Dynamic Factory Automation: Creating Flexible Systems for Competitive Manufacturing (Ibm Mcgraw-Hill Series)" by Alastair Ross
3. Quick Start Guide to Industry 4.0: One-stop reference guide for Industry 4.0 by Mr Kiran Kumar Pabbathi
4. Industry 4.0 for SMEs: Challenges, Opportunities and RequirementsDominik T. Matt, Vladimír Modrák, Helmut Zsifkovits, Springer Nature, 2020

B Tech (Common to all Programs) Semester - VIII
Course work with Capston Project
University Open Elective II

UE 404.4 Costing & Cost Control

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

To provide an in depth study of the Cost Accounting Principles and Techniques for identification, analysis and classification of cost components to facilitate managerial decision making. Learning aims

Course Learning Outcomes:

After successful completion of the course, students will be able to

1. Understand and explain the conceptual framework of Cost Accounting
2. Explain the basic concepts and processes in determination of cost of products and services
3. Understand the Cost Accounting Standards (CAS)
4. Apply marginal costing in decision making
5. Apply the concept of Standard Costing for variance analysis

Course Content

1. Introduction to Cost Accounting (6)

Definition, Scope, objectives and significance of cost accounting, its relationship with financial accounting and management accounting, Cost Objects, Cost centers and Cost Units, Elements of cost, Classification of costs

2. Cost Ascertainment - Elements of Cost (6)

Material Costs - Inventory Accounting & Valuation, Physical Verification, treatment of losses Scrap, spoilage, defectives and wastage.

Labour Costs - Principles and methods of remuneration and incentive schemes, Employee cost reporting and measurement of efficiency.

Direct Expenses & Overheads - Collection, classification and apportionment and allocation of overheads, Absorption and treatment of over or under absorption of overheads, Reporting of overhead costs

3. Methods of Costing (6)

Job Costing, Batch Costing, Contract Costing, Process Costing – Normal and abnormal losses, equivalent production, Joint and By Products, Operating Costing or Service Costing

4. Cost Accounting Techniques (6)

Marginal Costing, Standard Costing & Variance Budget and Budgetary Control (simple problems only) (i) Concepts, Types of Budgets (ii) Budgetary Control Vs Standard Costing (iii) Advantages and limitations (iv) Preparation of Budgets (simple problems only), Cost control, Cost Reduction, Introduction to activity based costing.

References

1. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
3. Cost Accounting: B. Jawaharlal (TMH)
4. Cost Accounting: R.R. Gupta.
5. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)
6. Cost Accounting: Jain, Narang (Kalyani Publishers)
7. A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang, (Satya Prakashan)

B.Tech. Semester VIII (All Programs)
Course work with Capston Project
University Open Elective II

UE-404.5 Autotronics

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

This course introduces the students about fundamentals of electronic engine & chassis management system & their components, various types of sensors, Methods & controls of electronic fuel injection & ignition system, various automotive Electrical, Comfort & Safety systems and the system approach to control & instrumentation & Electromagnetic Interference Suppression.

Course Outcomes

After successful completion of the course, students will be able to

1. Identify different areas of Autotronics, Sensors & Actuators
2. Differentiate various electronic fuel injection & control methods
3. Explain Automotive Electrical, Comfort & Safety system
4. Explain system approach control & instrumentation

1. **Fundamentals of Automotive Electronics, Sensors & Actuators** (6)

Microprocessor and micro Computer applications in automobiles, components for engine management System, electronic management of chassis system, vehicle motion control, and electronic panel meters. Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays.

2. **Electronic Fuel Injection & Ignition System & Digital Engine Control** (6)

Introduction; feedback carburetor system; throttle body injection and multi point fuel injection System; injection system controls; advantage of electronic ignition systems; types of solid state system and their principle of operation; electronic spark timing. Open loop and closed loop control system; engine cooling and warm-up control; acceleration, deceleration and idle speed control; integrated engine control system; exhaust emission control engineering; on-board diagnostics

3. **Automotive Electrical, Comfort & Safety** (6)

Batteries, starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices. Seats, mirrors and sun roofs; central locking and

electronic Windows; cruise control; in-car multimedia; security; airbag and belt tensioners; other safety and comfort systems; new developments.

4. **The system approach to control & instrumentation & Electromagnetic Interference Suppression** (6)

Fundamentals, electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments.

Electromagnetic compatibility Electronic dash board instruments - Onboard diagnosis system, Security and warning system.

Reference Books

1. Automotive Electronics Handbook, Ronald K. Jurgen, McGraw Hill Publishing Co.,

2. Automotive Electricity and Electronics, Al Santini, Delmar Publishers,

3. Automobile Electrical & Electronic Equipments, Young, Griffitns, Butterworth Publication, London.

4. Understanding Automotive Electronics, Bechfold, SAE 1998

B.Tech. Semester VIII (All Programs)
Course work with Capston Project
University Open Elective II

UE-404.6 Sensor Technology

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

This course introduce the various types of sensors, technology, and their applications The lectures cover the principles and operation of a variety of sensor architectures and modalities, including sensors used for mechanical quantities such as pressure, strain, displacement, proximity, and thermal, electric and magnetic field, optical, acoustic. Simple sensor signal processing algorithms and wired are also discussed. Additionally, the lecture also introduces the methods of interfacing sensors to electronic systems.

Course Outcomes

After successful completion of the course, students will be able to

1. Explain the principles of operation of the main types of sensors
2. Utilise the merits of various types of sensors for a wide range of applications
3. Analyse the specifications of various types of sensors
4. Select appropriate sensors for a given application and design simple electronic sensor interface systems

Course Contents

UNIT I : Measurements, instrumentation and sensors (6)

Review of Static characteristics of Instrument systems, dynamic characteristics of Instrument systems, Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor CharacteristicsPhysical Principles of Sensing, Dynamic Models of Sensor Elements

UNIT II : Thermal Sensors (6)

Definition of Temperature: Thermal Energy, absolute and relative Temperature, • Metal resistance versus temperature devices: Resistance versus Temperature Approximations, • Resistance-Temperature Detectors (RTD)Thermistors: Semiconductor Resistance versus Temperature, Thermistor Characteristics, • THERMOCOUPLES: Thermoelectric Effects, Thermocouple Characteristics, Thermocouple Sensors • Other thermal sensor: Bimetal Strips, Gas Thermometers, VaporPressure Thermometers, Liquid-Expansion Thermometers • Solid-State Temperature Sensors • Design considerations

UNIT III : Mechanical Sensors (6)

Displacement, Location, or Position Sensors: Resistive-, Capacitive-, and Inductive Sensors • Variable-Reluctance Sensors, LVDT • Level Sensors • Metal Strain Gauges and Semiconductor Strain Gauges (SGs) • Load CellsMotion sensors: Types of Motion, Accelerometer Principles, Types of Accelerometers • Pressure sensors: Pressure Principles, • Pressure Sensors ($p > 1$ atmosphere), • Pressure Sensors ($p < 1$ atmosphere) • Flow sensors: Solid-Flow

– and Liquid Flow Measurement • Pipe Flow Principles, Restriction Flow Sensors, Obstruction Flow Sensor • Magnetic Flow Meter

UNIT IV : Optical Sensors (6)
Fundamentals of EM radiation • Nature of EM Radiation, Characteristics of Light, • Photometry • Photodetectors: Characteristics, Photoconductive Detectors, Photovoltaic Detectors, • Photodiode Detectors •Photoemissive Detectors • PYROMETRY: Thermal Radiation, Broadband Pyrometers, Narrowband Pyrometers

Reference books:

"Process Control Instrumentation Technology, 6th Edition", Author: Curtis D. Johnson, Publisher: Prentice Hall International Edition, ISBN: 0-13-978-200-3
"Measurement, Instrumentation, and Sensors Handbook", John G. Webster., Publisher: CRC – Press – Taylor and Francis Group,
"Introduction to Instrumentation and Measurement, 3rd Edition", Authors: Robert B. Northrop, Publisher: CRC – Press – Taylor and Francis Group, ISBN: 13: 978-1-4665-9679
Handbook of Modern Sensors:Physical, Designs, and Applications, J. Fraden, AIP Press, Springer
Sensors and Transducers, D. Patranabis, PHI Publication, New Delhi
Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited)

B.Tech. Semester VIII (All Programs)
Course work with Capston Project
University Open Elective II
UE-404.7 Nanotechnology

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

Nanotechnology is the emerging technology and has touched almost all engineering areas like spintronics, sensors and actuators, small materials for building constructions, enhancing the capacity of memory devices, fabrication of nanodevices for medical fields etc. So this course is designed to provide the basic knowledge of nanoscience to technology students so that they can find proper application of nanoscience in their technical filed.

Course Outcomes

After successful completion of the course, students will be able to

1. **Explain** basic science of nanomaterials.
2. **Identify** different methods of synthesis of nanomaterials.
3. **Compare** properties of materials in bulk form with the nanomaterials.
4. **Discuss** the role of nanomaterials in various applications.

Units	Description	Hours
I	**Introduction to Nanoscience** Introduction, why nanoscience: particle size versus surface area, scientific revolutions, basic science behind nanotechnology, nanometer, materials at nanoscale, surface chemistry of materials: surface energy, concept of density of states, quantum confinement in nanomaterials.	06
II	**Synthesis of Nanomaterials** Introduction to approaches of synthesizing nanomaterials. **Top-down approach:** Examples of methods like Ball milling method, laser ablation method **Bottom-up approach:** Examples of methods like spray pyrolysis, chemical vapor deposition Introduction to lithography.	06
III	**Properties of Nanomaterials** **Physical Properties:** Melting point, Elasticity, Young's modulus of nanomaterials with examples, effect of size on physical properties of nanomaterial **Electronic and optical properties:** band structure of nanomaterials, effect of size on band structure, effect of band structure on optical properties. **Magnetic Properties:** GMR effect, particle size and coercivity relation, superparamagnetism of nnaomaterials	06
IV	**Rising Nanomaterials and applications of nanomaterials** Introduction, carbon: graphite, diamond, fullerenes, graphene, band structure of graphene in brief (no derivation) **Carbon Nanotubes** Structure and types of carbon nanotubes, properties of CNTs.	06

Applications of Nanomaterials

Nanoelectronics, MEMS/NEMS, nanosensors, nanocatalysts, food and agricultural industry, cosmetics and consumer goods, structure and engineering, automobile, water treatment and environment, medical field, textile, paint, energy, defense and space applications, structural applications, Applications of CNTs and graphene.

Reference Books

1. M. A. Shah and K. A. Shah, Nanotechnology, The Science of Small, Wiley Publishers, Edition 1, 2013.
2. M. S. Rao and Sgubra Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley Publishers, Edition 1, 2013.
3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay, A.N Banerjee, PHI Publications
4. Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Wiley-VCH (2006).

B Tech (Common to all Programs) Semester VIII
Course work with Capston Project
University Open Elective II

UE 404.8 Leadership

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

Engineers wanting to advance their careers must be able to lead teams effectively. This Specialization is designed for professional engineers who are interested in advancing into leadership and management roles.

Course Outcomes

After successful completion of the course, students will be able to

1. Develop awareness of their own strengths and weaknesses as a leader, and learn to leverage their strengths and overcome their weaknesses when they are placed in charge of a team or project.
2. Learn to manage relationships with team members and colleagues through proven coaching, mentoring, and conflict resolution techniques.
3. Establish goals and planning methods designed for success.
4. Learn learn how to set up a creative environment for their team, and motivate each team member to reach his or her potential.

Course Contents

1. Introduction to Leadership: (6)

Significance and components of leadership, Personal characteristics that support effective leadership. Types of leadership Styles, Trait approach in theories of leadership. Leader and values. The significance of self-knowledge for the role of leader (identity and integrity of leader). Emotions and self-management, emotional intelligence and its significance in the role of leader.

2. Leadership of workgroups and teams: (6)

Group structure and dynamics. Formation of teams and team work. Group problem-solving. Team excellence. Participative leadership. Leadership development. Skills for leaders and performance management: Goal setting, support for employee development and communication of feedback; delegation; resolving conflict situations and negotiation, Coaching and mentoring.

3. Creative leadership: (6)

Influence on the creative potential of work groups and teams; formation of innovative climate in organizations, Developing Leader-Follower trusting relationships.

4. Leading change in organizations:

Trust, Integrity and Ethics, Transactional and transformational leadership. Models of well balanced and authentic leadership, Organizational Culture (What makes great places to work), Effective Workplace Communication, Personal Code of Ethics, Valuing Diversity.

Reference Books

1. Art and Science of Leadership. Afsaneh Nahavandi. Prentice-Hall, 7th Edition. ISBN-10:0133546764 ISBN-13: 9780133546767
2. Leadership for Engineers: The Magic of Mindset (Basic Engineering Series and Tools). Ronald Bennett, Elaine Millam. McGraw-Hill Education – Europe. ISBN10 007338593X, ISBN13 9780073385938
3. Dubran A,J. Principles of leadership [Mason] Southwestern/Cengage Learning 2013
4. Achua C.F – Lussier R N. Effective leadership [Mason] Southwestern/Cengage Learning 2010
5. Kouzes J.M., Posner B. Z. Learning Leadership. The Five Fundamentals of Becoming an Exemplary Leader. Wiley. 2016
6. Yuki G. Leadership in Organizations. Eighth Edition. Pearson Education. 2013. ISBN 978-0132771863

B Tech (Common to all Programs) Semester - VIII
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UE 404.9 Entrepreneurship Development

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

To familiarize students with fundamentals of Entrepreneurship and to encourage them to become successful entrepreneurs.

Course Outcomes:

The students shall demonstrate the knowledge of Entrepreneurship and shall be motivated to become successful entrepreneurs.

1. Entrepreneurship & SSI (6)

Definition of Entrepreneur and entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, Indian scene

Entrepreneurial Motivation: Self-disclosure, personality effectiveness, risk taking, entrepreneurial competencies, case studies.

Small Scale Units: Concept and definition, role of S.S.I. in Indian economy, government policies and facilities.

Planning Small Scale Business: Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation.

Small Business Management: Techniques of marketing, materials, production, manpower and financial management, crisis management, working capital management, fixed capital assessment, cash flow analysis, ROI, techniques of decision making.

2. Managerial Economics & Business Accounting (6)

Introduction to Economics, Kinds of Economic Decisions, Significance and applicability of Managerial Economics in decision making, Role and responsibilities of Managerial Economics, Economic principles relevant to managerial decision making, Opportunity cost, Production possibility curve, Concept of increments and Margin, Discounting principle

Business Accounting: Study of Balance sheets, Profit and Loss statements. Need, format of Trading and Profit and Loss A/c., Items to be recorded on the Debit and Credit Side of Trading and Profit and Loss A/c, Preparation of Trading and Profit and Loss A/c. Need, format of Balance Sheet, identification of Accounts to be written on liabilities and Assets side, Preparation of Balance sheet. (Analytical Problems)

3. Government Support Organizations (6)

The detailed study of the government support system for the entrepreneurship development

a) Central Government
b) State government
c) Financial support organizations
d) Government schemes and procedures

4. Business plan preparation & Statutory Requirements (6)

Meaning of business plan, project parameters, information sources of economical and technical knowhow, Preparation of project report

Factories Act 1948, Industrial disputes Act 1947, Indian Contract Act, Indian sales and Goods Act, Indian Partnership Act, Central Excise, Sales tax, Income Tax Act, Value Added Tax (VAT). Business ethics, export environment, procedure and documentation, venture capital financing, intellectual property act, patents

References

1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of New Entrepreneurs
3. Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)

B Tech (Common to all Programs) Semester - VIII
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University Open Elective II

UE 404.10 Human Values and Professional Ethics

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
2	-	-	2	Theory	FET	20	40
					CAT	30	
					ESE	50	40

Course Description

The objective of the course is an exploration of human values which go into making a good human being, a good human society and a good life. The context is the work life and the personal life of modern Indian professionals. The movement to identify and promote the values shared by societies around the world is relatively new. It is only in recent years as globalization extended its reach to even remote corners of the earth that he needs to refocus and build upon what we as a human society have in common, has become apparent. Increased contact between peoples and nations enhances awareness of our kinship and the shared code of ethics and conduct that underlies all civilization. It's the Human values that we must now promote to create a common vision and means for moving forward toward a more peaceful and sustainable world.

The course also aims to have students appreciate the vastness of the Universe and the wonder of its parts, and the philosophical significance of this for improving the quality of human life through value clarification.

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the role of cognitive and moral values in world views, by discussing and writing about the ethical implications of modern scientific and technological results
2. Recognize the difference between matters of fact and matters of value, while understanding the important ways in which facts influence value assessments and how value judgments shape our vision of "the facts"
3. Understand ethical methodologies and competency in ethical deliberation on rationally applying these methodologies to contemporary ethical questions related to scientific progress and technological power
4. Understand why ethics plays an important role in science and technology

Course Content

1. **Human Values** (6)

The value-crisis in the contemporary Indian Society-The Indian system of values-Values in the Indian constitution-Aesthetic values: perception and enjoyment of beauty-Relative and absolute values-Morals- Values and Ethics – Integrity-Service – Work Ethic –Service Learning – Civic Virtue – Respect for Others –Respect for the Environment-Quest for Living Peacefully and happily–Attitude of Nonviolence-Innate dignity for human life – Bring out the best in oneself - caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

2. **Engineering Ethics** (6)

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of
Professional Roles - theories about right action- Self-interest - customs and religion - uses of ethical theories.

3. **Engineering as Social Experimentation** (6)

Engineering as experimentation - engineers as responsible experimenters - Research Ethics - codes of ethics - a balanced outlook on law - the challenger case study, Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - The Government Regulator's Approach to Risk- the three mile island, Chernobyl and Bhopal case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime

4. **Responsibilities, Rights and Global Issues** (6)

Multinational corporations - Business Ethics -Environmental ethics –Role in Technological Development- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -Honesty-moral leadership-sample codes of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India,etc.

Reference Books

1. "Professional Ethics and Human Values", M.P. Raghavan,Scitech Publications (India) Pvt Ltd.
2. "Human Values and Professional Ethics", Jayashri and Suresh B S ,S Chand .
3. "Ethics in Engineering", Mike Martin and Roland Schinzinger, , Tata McGraw-Hill, New York, (1996).
4. "Engineering Ethics(Including Human Values)",Govindarajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi.
5. "A Textbook on Professional Ethics and Human Values", Naagarazan, R.S. ,New Age Publishers .
6. "Professional Ethics and Human Values",A Alavudeen,R Kalil Rahman M Jayakumaran ,Laxmi Publisher .
7. "Understanding Human Values :Individual and Societal",Milton Rokeach ,Free Press Publication .
8. "Human Values" A N Tripathy, New Age International .
9. "A Foundation Course in Value Education",R R Gaur,R Sangal,(2009).
10. "Science and humanism", P L Dhar and R R Gaur, Commonwealth Publishers.
11. "Wisdom for The New Millennium",H.H .Sri Sri Ravishankarji, founder ,Art of Living, Vyakti Vikas Kendra, Bangalore.
12. "The Monk Who Sold his Ferrari",Robin Sharma, Jaico Publishing House .
13. "Mega Living",Robin Sharma, Jaico Publishing House .