`Dr. Mahalingam College of Engineering and Technology

(An Autonomous Institution)

Pollachi - 642 003

Curriculum and Syllabus

B.E. PRODUCTION ENGINEERING

SEMESTER I to VI

REGULATIONS 2016

DR MAHALINGAM

MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Bridging Education, Technical Minds

DEPARTMENT OF PRODUCTION ENGINEERING

2016 REGULATION

Curriculum for B.E Production Engineering from Semester I to VIII

SEMESTER I

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16ENT11	COMMUNICATION SKILLS – I	2	0	2	3	100
16MAT11	ENGINEERING MATHEMATICS – I	3	2	0	4	100
16PHT11	APPLIED PHYSICS	3	0	0	3	100
16CYT11	APPLIED CHEMISTRY	3	0	0	3	100
16GET11	INTRODUCTION TO ENGINEERING	2	0	2	3	100
PRACTICAL						
16EGL11	ENGINEERING GRAPHICS	2	0	4	4	100
16PCL11	PHYSICS AND CHEMISTRY LABORATORY	0	0	4	2	100
PROFESSIONAL SKILLLS						
16PSL11	PROMOTION OF STUDENTS' WELLNESS	0	0	2	1	100
TOTAL		**15**	**2**	**14**	**23**	**800**

SEMESTER II

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16ENT21	COMMUNICATION SKILLS - II	2	0	2	3	100
16MAT21	ENGINEERING MATHEMATICS – II	3	2	0	4	100
16PHT21	MATERIAL SCIENCE	3	0	2	4	100
16GET21	ENGINEERING MECHANICS	4	0	0	4	100
16GET22	ENGINEERING METROLOGY AND MEASUREMENTS	2	0	2	3	100
PRACTICAL						
16EPL21	ENGINEERING PRACTICES LABORATORY	0	0	4	2	100
16CDL21	COMPUTER AIDED DRAFTING AND MODELING LABORATORY	1	0	4	3	100
PROFESSIONAL SKILLLS						
16PSL21	SPORTS FOR WELLNESS	0	0	2	1	100
TOTAL		**15**	**2**	**16**	**24**	**800**

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SEMESTER III

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16MAT31	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	3	2	0	4	100
16PET31	FOUNDRY TECHNOLOGY	3	0	0	3	100
16PET32	STRENGTH OF MATERIALS	2	2	0	3	100
16MET31	ENGINEERING METALLURGY	2	0	2	3	100
16PET33	THEORY OF MACHINES	3	0	2	4	100
16PET34	BASIC ENGINEERING THERMODYNAMICS	2	2	0	3	100
PRACTICAL						
16PEL31	STRENGTH OF MATERIALS LABORATORY	0	0	4	2	100
16PEL32	MANUFACTURING PROCESSES LABORATORY	0	0	4	2	100
PROFESSIONAL SKILLLS						
16PSL31	PERSONAL EFFECTIVENESS	0	0	2	1	100
OCC	ONE CREDIT COURSE	0	0	2	1	100
TOTAL		**15**	**6**	**16**	**26**	**1000**

SEMESTER IV

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16MAT41	NUMERICAL METHODS	3	2	0	4	100
16EET45	ELECTRICAL DRIVES AND CONTROLS	3	0	0	3	100
16MET42	METAL CUTTING PROCESSES	3	0	0	3	100
16PET41	FLUID MECHANICS AND MACHINERY	3	0	2	4	100
16PET42	WELDING TECHNOLOGY	2	0	2	3	100
16PET43	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	3	0	0	3	100
PRACTICAL						
16EEL43	ELECTRICAL DRIVES AND CONTROLS	0	0	4	2	100
16MEL41	METAL CUTTING PROCESSES LABORATORY	0	0	4	2	100
PROFESSIONAL SKILLLS						
16PSL41	ETHICAL AND MORAL RESPONSIBILITY	0	0	2	1	100
OCC	ONE CREDIT COURSE	0	0	2	1	100
TOTAL		**17**	**2**	**16**	**26**	**1000**

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SEMESTER V

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16MET51	DESIGN OF MACHINE ELEMENTS	3	2	0	4	100
16PET51	METAL FORMING TECHNOLOGY	3	0	0	3	100
16PET52	ENGINEERING STATISTICS AND QUALITY CONTROL	3	0	0	3	100
16PET53	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3	100
16PET54	CNC MACHINES AND CONTROL SYSTEMS	3	0	0	3	100
	ELECTIVE I	3	0	0	3	100
PRACTICAL						
16MEL52	COMPUTER AIDED MACHINE DRAWING LAB	0	0	4	2	100
16PEL51	FLUID POWER LABORATORY	0	0	4	2	100
PROFESSIONAL SKILLLS						
16PSL51	TEAMNESS AND INTER-PERSONAL SKILLS(TIPS)	0	0	2	1	100
	ONE CREDIT COURSE	0	0	2	1	100
TOTAL		**18**	**2**	**12**	**25**	**1000**

SEMESTER VI

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16PET61	FINITE ELEMENT ANALYSIS IN MANUFACTURING	3	2	0	4	100
16PET62	JIGS, FIXTURES AND DIE DESIGN	3	0	0	3	100
16PET63	TOTAL QUALITY MANAGEMENT	3	0	0	3	100
16PET64	UNCONVENTIONAL MACHINING PROCESSES	3	0	0	3	100
16PET65	PRODUCTION PLANNING AND CONTROL	3	0	0	3	100
	ELECTIVE II	3	0	0	3	100
PRACTICAL						
16MEL61	SIMULATION AND ANALYSIS LABORATORY	0	0	4	2	100
16PEL61	CNC MACHINE LABORATORY	0	0	4	2	100

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PROFESSIONAL SKILLLS						
16PSL61	CAMPUS TO CORPORATE	0	0	2	1	100
	ONE CREDIT COURSE	0	0	2	1	100
TOTAL		**18**	**2**	**12**	**25**	**1000**

SEMESTER VII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16CET73	ENVIRONMENTAL STUDIES	3	0	0	3	100
16MET71	MECHATRONICS	3	0	0	3	100
	ELECTIVE III	3	0	0	3	100
	ELECTIVE IV (OPEN)	3	0	0	3	100
PRACTICAL						
16MEL71	MECHATRONICS LABORATORY	0	0	4	2	100
16MEL72	PRODUCT DESIGN LABORATORY	0	0	4	2	100
16PEL71	CREATIVE AND INNOVATIVE PROJECT	0	0	8	4	200
TOTAL		**12**	**0**	**16**	**20**	**800**

SEMESTER VIII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
	ELECTIVE-V	3	0	0	3	100
	ELECTIVE-VI	3	0	0	3	100
	ELECTIVE-VII	3	0	0	3	100
PRACTICAL						
16PEL81	PROJECT	0	0	20	10	200
TOTAL		**9**	**0**	**20**	**19**	**500**

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SUMMARY	
Core Curriculum Credits	178
Professional Skills Credits	6
One Credit Courses Credits	4
Total No. of Credits	188
Core Curriculum Courses	57
Professional Skills Courses	6
One Credit Courses	4
Total No. of Courses	**67**

ELECTIVES

Course Code	Course Title	Hours / Week			Credits	Marks
		L	T	P		
16MEE18	PROCESS PLANNING AND COST ESTIMATION	3	0	0	3	100
16PEE01	SURFACE ENGINEERING AND ANALYTICAL TECHNIQUES	3	0	0	3	100
16MEE25	MANUFACTURE AND INSPECTION OF GEARS	3	0	0	3	100
16PEE02	CLOUD MANUFACTURING AND INTERNET OF THINGS	3	0	0	3	100
16PEE03	QUALITY ASSURANCE AND RELIABILITY	3	0	0	3	100
16MEE20	FLEXIBLE MANUFACTURING SYSTEMS	3	0	0	3	100
16MEE44	QUALITY ENGINEERING	3	0	0	3	100
16MEE32	AUTOMOTIVE FUNDAMENTALS AND MANUFACTURING	3	0	0	3	100
16MEE30	ADDITIVE MANUFACTURING	3	0	0	3	100
16MEE21	NON DESTRUCTIVE TESTINGMETHODS	3	0	0	3	100
16MEE22	SUPPLY CHAIN MANAGEMENT	3	0	0	3	100
16MEE37	ADVANCED MANUFACTURING PROCESSES	3	0	0	3	100

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16MEE42	INDUSTRIAL SAFETY MANAGEMENT	3	0	0	3	100
16PEE04	PLANT LAYOUT AND MATERIAL HANDLING	3	0	0	3	100
16MEE48	OPERATIONS RESEARCH	3	0	0	3	100
16MEE27	LEAN MANUFACTURING	3	0	0	3	100
16MEE47	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3	100
16MEE26	MICRO AND NANO MANUFACTURING	3	0	0	3	100
16PEE05	ARTIFICIAL INTELLIGENCE	3	0	0	3	100
16MEE24	NANOMATERIAL SYNTHESIS AND APPLICATIONS	3	0	0	3	100
16PEE06	PRODUCTION MANAGEMENT	3	0	0	3	100
16PEE07	ENGINEERING ERGONOMICS	3	0	0	3	100
16PEE08	PRODUCT DATA MANAGEMENT	3	0	0	3	100
16PEE09	INDUSTRIAL TRIBOLOGY	3	0	0	3	100
16MEE41	TOTAL PRODUCTIVE MAINTENANCE	3	0	0	3	100
OPEN ELECTIVES						
16OEXXX	MANUFACTURING INFORMATION SYSTEMS	3	0	0	3	100
16OEXXX	ENGINEERING ECONOMICS AND COST ANALYSIS	3	0	0	3	100
16OEXXX	PROBABILITY AND STATISTICS	3	0	0	3	100

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SEMESTER I

Course Code: 16ENT11	**Course Title:** COMMUNICATION SKILLS I (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	**L: T : P : C**	3: 0 : 2 : 3
Type: Theory	**Total Contact Hours:**	60 Hours

Prerequisites

- The student should have undergone English as his/her first or second language in school.

Course Objectives

The course is intended to:

1. Listen to conversations, comprehend and answer questions.
2. Answer questions about one self and business-related theme.
3. Read passages, infer and respond to the questions.
4. Write appropriate business e mail, note, memo and letter.
5. Write simple and grammatically correct sentences

UNIT I LISTENING **6+6**

Short conversations/monologues - numbers and spelling (dates, prices, percentages, figures, etc.) - and locate specific information - longer monologue and guided note taking - gap filling - Understanding the gist and extracting the main idea.

UNIT II SPEAKING **6+6**

Answering questions about oneself, agreeing and disagreeing, expressing preferences - mini-presentation on a business theme (Oral) - Giving information and expressing opinions - discussion on business related topics – initiate a conversation and respond appropriately - business vocabulary - collocation.

UNIT III READING **6+6**

Read short texts and understand the main message (signs, messages, postcards, notes, emails, labels) - Read and find specific information - Interpreting visual information - Comprehend detailed factual information - gather gist – cloze test

UNIT IV WRITING **6+6**

Internal written communication - short messages to colleagues - note, message, memo, email- External communication - letter, email, notice - set phrases for letters and e-mails- Discourse markers, sign post words.

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UNIT V GRAMMAR **6+6**

Types of sentences – Declarative, interrogative, imperative and exclamatory – Usage of tenses (Simple and continuous forms) - Voices – Concord (Subject and verb) - Auxiliary - Infinitive and Gerunds – Article - Preposition - Comparative and superlative adjectives.

Course Outcomes

At the end of the course students will be able to:

CO1: Listen to conversations, comprehend and answer questions equivalent to BEC preliminary listening exercises.
CO2: Answer questions about oneself and business-related themes on par with BEC preliminary speaking tests.
CO3: Read passages, infer and respond to the questions from BEC preliminary reading exercises .
CO4: Write appropriate business e mail, note, memo and letter on par with BEC preliminary writing tests.
CO5: Write simple and grammatically correct sentences.

Text Books

1. Whitby Norman, "Business Benchmark Pre-intermediate to Intermediate Students" Book CUP Publications, 2nd Edition, 2014.
2. Wood Ian, Williams Anne, Cowper Anna, "Pass Cambridge BEC Preliminary", Cengage Learning, 2nd edition, 2015.

References

1. "BEC Preliminary Cambridge Handbook for Language Teacher", 2nd Edition, CUP 2000.
2. Hewings Martin "Advanced Grammar in use - Upper-intermediate Proficiency", CUP, Third Edition, 2013.

Web references

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.pearsonlongman.com/intelligent_business/bec_tests/preliminary.html

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Course Code: 16MAT11	**Course Title:** ENGINEERING MATHEMATICS - I (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	**L : T : P : C**	3 : 2 :0 : 4
Type: Theory	**Total Contact Hours:**	75 Hours

Course Objectives

The course is intended to:

1. Determine the canonical form of a quadratic form.
2. Determine the curvature and equation of evolutes of a curve.
3. Identify the extreme values for two variable functions.
4. Determine the area of bounded curves and volume of solids.
5. Solve the various types of first order ordinary differential equations

UNIT I EIGENVALUES AND EIGENVECTORS 9+6

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation–Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 9+6

Curvature – Cartesian and polar coordinates – Radius and Centre of curvature - Circle of curvature – Involutes and Evolutes – Envelopes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+6

Partial derivatives – Homogeneous functions and Euler's theorem –Total derivative – Change of variables – Jacobians –Partial differentiation of implicit functions – Taylor's series for functions of two variables –Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS 9+6

Double integration-Cartesian and polar coordinates-Change of order of integration-Transformation from Cartesian to polar, spherical and cylindrical coordinates-Triple integration in Cartesian Coordinates-Applications: Evaluating area and volume using multiple integrals.

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UNIT V ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER 9+6

Formation of ordinary differential equation-Solution of differential equations of first order and first degree: homogeneous form, linear form and exact differential equations - Applications to engineering problems related to resisted motion.

Course Outcomes

At the end of the course students will be able to:

CO1: Determine the canonical form of a quadratic form using orthogonal transformation.
CO2: Determine the curvature and equation of evolutes of a curve using differential calculus.
CO3: Identify the extreme values for two variable functions using partial derivatives.
CO4: Determine the area of bounded curves and volume of solids using multiple integrals.
CO5: Solve the various types of first order ordinary differential equations.

Text Books

1. Srimanta Pal & Subodh C. Bhunia. "Engineering Mathematics", First edition, 2015, Oxford University Press.
2. Ervin Kreyszig. "Advanced Engineering Mathematics", 10th edition, 2015, Wiley India.

References

1. Peter V. O'Neil. "Advanced Engineering Mathematics", 7th Edition, 2012, Thomson Nelson, Toronto.
2. K.A. Stroud & Dexter J. Booth. "Advanced Engineering Mathematics", 5th Edition,2011, Palgrave Macmillan.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

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Course Code: 16PHT11	**Course Title:** APPLIED PHYSICS (Common to Production,Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	3 : 0 :0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Course Objectives

The course is intended to:

1. Calculate the equilibrium condition of particles and rigid bodies.
2. Apply the knowledge of conduction and radiation in materials.
3. Impart the knowledge of Ultrasonics to inspect the quality of materials.
4. Know the process of vacuum creation and its measurement.
5. Apply lasers for various industrial applications.

UNIT I BASICS OF MECHANICS **10**

Review of fundamental laws of mechanics – scalars, vectors - Newton's law of mechanics, Gravitational law. Particles and rigid body, Concept of force and its effect on rigid body system of forces-Free body diagram-principle of transmissibility-equilibrium conditions-equilibrium of particles subjected to coplanar and non-coplanar force system - Triangle law, Parallelogram law and Lami's theorem.

UNIT II TRANSMISSION OF HEAT **8**

Conduction – Co-efficient of the thermal conductivity – Cylindrical flow of heat – determination of thermal conductivity of bad conductor – Lee's disc method - Experimental determination of Specific heat of liquid, variation of specific heat and atomic heat with temperature. Radiation– Black body – Wein's Law - Rayleigh Jeans Law – Stefan's law – Experimental Determination of Stefan's constant.

UNIT III ULTRASONICS AND NDT **10**

Properties of Ultrasonic waves, Production of ultrasonics by magnetostriction and piezoelectric methods –Detection of ultrasonics: acoustic grating –Cavitation -. Industrial applications: ultrasonic cleaning, welding and cutting. Non Destructive Testing: Principle of Ultrasonic testing – ultrasonic transducer – Couplant – Inspection techniques: Liquid Penetrant Method, Radiographic testing, Ultrasonic flaw detector: Pulse echo system, transmission, A, B & C scan displays. Inspection standards.

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UNIT IV VACUUM SCIENCE AND TECHNOLOGY 9

Introduction concepts of vacuum – throughput, pumping speed, effective pumping speed and conductance. Types of pumps – working principle and construction of rotary pump, diffusion pump, turbo molecular pump. Operation of pressure gauges – pressure range, measurement of vacuum using Pirani and Penning gauges, merits and limitations - Working of a vacuum system.

UNIT V LASER PHYSICS AND APPLICATIONS 8

Laser principles: Stimulated and spontaneous emissions of radiations - Population inversion and pumping methods – Properties of lasers - Nd: YAG laser and CO_2 molecular laser – Applications of Lasers: welding, brazing, drilling, cutting and heat treatment of materials.

Course Outcomes

At the end of the course, the students will be able to:

CO1: Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.
CO2: Compute the amount of heat transfer by conduction and radiation in materials.
CO3: Apply the knowledge of Ultrasonics to inspect the quality of materials through NDT.
CO4: Use the different types of pumps and gauges.
CO5: Apply lasers in various industrial applications.

Text Books

1. R. C. Hibbeller, "Engineering Mechanics: Combined static and dynamics", Prentice Hall, 2009
2. Rajendran, "Engineering Physics", Tata McGraw Hill Publishing Company limited. New Delhi, 2009.

References

1. BrijLal and Dr. N. Subrahmanyam, "Heat and Thermodynamics", S. Chand & Company Ltd., New Delhi, 1997.
2. 'David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics Extended", Ninth Edition, Wiley India.
3. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007

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Web References

- http://nptel.ac.in/courses/115106061/
- www.apsu.edu
- www.physicsclassroom.com
- www.study.com
- www.physics.org

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Course Code: 16CYT11	**Course Title** : APPLIED CHEMISTRY (Common to Production,Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	3 : 0 :0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Course Objectives

The course is intended to:

1. Explain the chemistry of the water treatment processes.
2. Select batteries based on the life cycle,
3. Determine the rate of corrosion of a given metal
4. Select a polymeric material for a engineering application
5. Describe the efficiency of fuels in different state
6. Identify appropriate lubricant for engineering applications

UNIT – I WATER TECHNOLOGY 9

Water Quality Parameters – Hardness – Types and expression - Determination of hardness by EDTA method. Boiler feed water. Boiler troubles – Sludge and Scale formation, Caustic embrittlement and Boiler corrosion. Methods of Boiler Water Treatment: Internal (Carbonate, Phosphate & Calgon) and External conditioning – Demineralization, Reverse Osmosis. Domestic Water Treatment.

UNIT – II ELECTROCHEMISTRY AND BATTERIES 9

Electrochemical Cells – Reversible and Irreversible cells, Galvanic Cells, Concentration Cells, Batteries: Characteristics, types - Dry Cell (Alkaline Battery), Lead-Acid, Lithium Ion (Li / TiS_2 and Li / S) – Construction, Working and Application. Batteries for automobiles. Fuel Cells - Construction and Working of Hydrogen - Oxygen fuel cell.

UNIT – III CORROSION AND CONTROL 9

Chemical Corrosion –Electrochemical corrosion – different types – galvanic corrosion, differential aeration corrosion, factors influencing corrosion. Corrosion control – sacrificial anode and impressed current cathodic methods – Corrosion inhibitors- Inorganic coating- Metallic coating – Galvanizing –Tinning- Organic coating. Electroplating of silver and electroless (Ni) - plating.

UNIT – IV POLYMER CHEMISTRY 9

Classification of Polymers – Thermoplastic and Thermosetting. Polymerisation: types – Addition, condensation and copolymerization, Properties of polymers: Tg, Tacticity,

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Molecular Weight (Weight average, Number average), polydispersity index. Compounding of plastics, Moulding techniques - blow and extrusion. Commodity plastics – Preparation, properties and uses of PE, and PET. Engineering plastics – Preparation, properties and uses of PC, Teflon, Foams - Preparation, properties and uses of PU and poly olefins.

UNIT – V FUELS AND LUBRICANTS 9

Calorific value (GCV and NCV) – metallurgical coke – manufacture by Otto-Hoffmann method – knocking – octane number and cetane number. Gaseous fuels- CNG and LPG - composition, properties and uses. Lubricants – types– properties of liquid lubricants and its significance. Greases – preparation, types and uses.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the chemistry of water and specify the water treatment processes.
CO2: Explain batteries based on the life cycle, working principle and their applications.
CO3: Determine the rate of corrosion of a given metal in a given environment and identify appropriate control techniques to avoid corrosion.
CO4: Identify a polymeric material for a specific engineering application.
CO5: Describe the fuel characteristics based on composition and calorific value.
CO6: Identify appropriate lubricant for different engineering applications

Text Books

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 16th Ed., Dhanpat Rai Pub, Co., New Delhi (2006).
2. "Engineering Chemistry", Second Edition, Wiley India Pvt. Ltd. New Delhi (2011).

References

1. L. Brown and T. Holme, "Chemistry for Engineering Students", 3rd Edition, Cengage Learning (2010).
2. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 9th Ed. (Indian Student Edition) (2011).
3. S.Chawla, "A Text Book of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi (2013).

Web References

- http://nptel.ac.in/courses/122101001/downloads/lec-23.pdf
- http://nptel.ac.in/courses/122101001/downloads/lec-25.pdf
- http://nptel.ac.in/courses/104105039/

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Course Code: 16GET11	**Course Title** : INTRODUCTION TO ENGINEERING (Common to Production, Mechatronics & Automobile)	
Core/Elective: Core	**L : T : P : C**	2 : 0 :2 : 3
Type: Theory	**Total Contact Hours:**	60 Hours

Course Objectives

The course is intended to:

1. Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies
2. Explain how the products that are used in day-to-day life
3. Explain the different scientific principles
4. Explain the different engineering disciplines
5. Observe every product with an engineering perspective
6. Explain the lab facilities and learning resources available in the institution

UNIT I ENGINEERING EDUCATION **12**

Expectations and Aspirations of engineering students, Graduate Engineering Attributes, Outcome based Engineering Curriculum, Engineering Skills – Technical and Professional. Courses, course map, Concepts and Theories of Learning – Higher Order Thinking Skills, Multiple Intelligences, learning styles inventory, teaching/learning process and methodologies (Theorys, tutorials, activities, lab/workshop exercises, factory visits, internships, projects, alignment to co-curricular activities and hobby projects) Rubrics, Assessment.

UNIT II SCIENCE AND ENGINEERING IN PRODUCTS **12**

Products used in day-to-day life, functions, science and engineering principles applied in the products disciplines, Working of the product, individual parts of the product, Scientific / Engineering principle. + Demonstration with Refrigerator, Wet Grinder, Pump, Windmill, Washing machine, Water purifier Motorbike, Microwave oven. Activity to explore working of products used in day to day life.

UNIT III MULTI-DISCIPLINARY ENGINEERING **12**

Mechanical Engineering: Introduction to manufacturing methods, materials, relative motion between parts (Linear and Circular) Fastening methods

Electrical and Electronics Engineering: Electricity system used for domestic and industrial purpose (AC vs DC, AC signal, Single-phase, Three-phase, prime movers (motors) in products used in day to day life, DC, Electrical components: resistor, capacitor, and

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inductor, Electronic components: diode, transistor, SCR, DIAC and TRIAC. IC and PCB. Computer science Engineering: Processor board, Computer peripherals, Operating system.

UNIT IV PRODUCT APPRECIATION 12

Essential needs in day-to-day life, Connections between the needs and the products, Product appreciation with engineering perspective

UNIT V LEARNING RESOURCE MANAGEMENT 12

Awareness and effective use of resources for learning: - library resources, professional societies, centres of excellences, and value-added divisions. Code of conduct for resource utilization.

Note: CO6 will be assessed only in formative assessment mode.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies
CO2: Explain how the products that are used in day-to-day life of students and family work/function
CO3: Explain the different scientific principles used in this product
CO4: Explain the different engineering disciplines used in this product
CO5: Observe every product with an engineering perspective
CO6: Explain the lab facilities and learning resources available in the institution and how they can utilize them effectively

References

1. Louis A. Bloomfield, "How things work - Physics of everyday life", Wiley publication 2013
2. C. David, "How it works: Printing and Processes", Ladybird book's publication
3. S. Peter, "How it works: Rockets and Space craft", Ladybird book's publication
4. Granada, " How things work", Granada, 1978
5. J. L. Adams, "Flying Buttresses, Entropy, and O-Rings: The World of an Engineer".
6. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor".
7. R.P. Feynman," Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher", 2011

Web References

- https://en.wikibooks.org/wiki/General_Engineering_Introduction/Engineering_Science
- http://science.howstuffworks.com/engineering-channel.htm

BoS Chairman

Course Code: 16EGL11	**Course Title** : ENGINEERING GRAPHICS (Common to Production,Mechatronics & Automobile)	
Core/Elective: Core	**L : T : P : C**	2 : 0 :4 : 4
Type: Theory	**Total Contact Hours:**	60 Hours

Course Objectives

The course is intended to:

1. Sketch different engineering curves
2. Prepare orthographic and isometric drawings
3. Prepare development of lateral surfaces.
4. Prepare perspective drawings

UNIT I CURVES USED IN ENGINEERING PRACTICES 12

Importance of graphics in engineering applications –BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning- Methods of Dimensioning. Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method –Construction of cycloid and involutes of square and circle – Drawing of tangents and normal to the above curves. Mathematical representation of these curves and their applications

UNIT II ORTHOGRAPHIC AND ISOMETRIC PROJECTION 12

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout of views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Orthographic projection of solids – Practices on three view projection of solids. Isometric Projection of solids – practices on simple solids

UNIT III PROJECTION OF LINES AND PLANE SURFACES 12

Projection of straight lines located in the first quadrant and inclined to both the planes – Concept of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes. Detailed factual information - gather gist – cloze test

UNIT IV PROJECTION OF SOLIDS AND ITS SECTION 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane. Need for sectioning of solids – Sectioning of simple solids

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like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

UNIT V DEVELOPMENT OF SURFACES AND PERSPECTIVE PROJECTIONS 12

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones. Concepts of Perspective projection of prisms, pyramids and cylinders by visual ray method.

Course Outcomes

At the end of the course students will be able to:

CO1: Sketch different engineering curves and explain its application.
CO2: Prepare orthographic and isometric drawings of simple solids
CO3: Prepare development of lateral surfaces of simple objects.
CO4: Prepare perspective drawings of regular solids

Text Books

1. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2013).
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).

References

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).
2. Cencil Jensen, Jay D. Helsel and Dennis R. "Short Engineering Drawing and Design". Tata McGraw Hill Publishing Company Limited (2012).
3. John.K.C and Verghese.P.I "Machine Drawing", Jovast Publishers, Trissur,2007.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. The mode of delivery is like practical.

Web References

- http://nptel.ac.in/courses/112103019/
- https://en.wikipedia.org/wiki/Engineering_drawing

BoS Chairman

Course Code: 16PCL11	**Course Title** :PHYSICS AND CHEMISTRY LABORATORY (Common to Production,Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	0: 0 :4 : 2
Type: Practical	**Total Contact Hours:**	60 Hours

Course Objectives

The course is intended to:

1. Use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

Physics Laboratory

1. Young's Modulus of the material – Cantilever bending method
2. Rigidity modulus of the metallic wire – Torsional Pendulum method
3. Thermal Conductivity of the insulator – Lee's Disc method
4. Comparison of Co-efficient of viscosity of the liquids
5. Wavelength of laser and determination of particle size using laser
6. Testing the optical planeness of the given glass plate
7. Thickness of the sample using Air Wedge
8. Efficiency of the solar cell

Chemistry Laboratory

I - Water Analysis

1. Determination of total hardness of water sample by EDTA method.

II - Viscometry

1. Determination of molecular weight of a polymer – Ostwald viscometric method.

III - Electrochemistry

1. To determine the strength of given acid – pH metrically
2. To determine the amount of ferrous ions by potentiometric titrations.

IV - Corrosion Testing

1. Determination of corrosion rate for mild steel specimen – weight loss method.
2. Determination of inhibitor efficiency of an organic inhibitor for mild steel specimen – weight loss method.

Course Outcomes

At the end of the course students will be able to:

CO1: Use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

References

1. "Engineering Physics Laboratory Manual" R. Jayaraman, V. Umadevi, S. Maruthamuthu and B. Saravanakumar.
2. "Engineering Chemistry Laboratory Manual" Faculty, Chemistry Department, MCET.

BoS Chairman

Course Code: 16PSL11	**Course Title** : PROMOTION OF STUDENTS WELLNESS (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	**L : T : P : C**	0: 0 :2 : 1
Type: PS	**Total Contact Hours:**	30 Hours

Course Objectives

The course is intended to:

1. Maintain physical wellbeing.
2. Maintain mental wellbeing.
3. Maintain social wellbeing.

Course Content

UNIT I PHYSICAL HEALTH

Physical structure and functions of human body – simplified physical exercises (hand exercises, Leg exercises, breathing exercises, eye exercises – kapalapathi – Maharasanas 1-2 – Massages – Acupuncture – relaxation – importance and benefits. Suryanamaskar.

UNIT II MENTAL HEALTH

Maintenance of youthfulness and life force – kayakalpa yoga – anti ageing process – benefits. Mind and its functions – mind wave frequency – meditation process – Agna, shanthi, thuriam – benefits

UNIT III PERSONALITY DEVELOPMENT – I

Purpose of life and analysis of thought – philosophy of life – introspection – practice. Moralization of desires and neutralization of anger - practices

UNIT IV PERSONALITY DEVELOPMENT – II

Eradication of worries and benefits of blessings – wave theory –practices. Genetic centre – purification – cause and effect theory

UNIT V SOCIAL HEALTH

Greatness of guru – cultural education – love and compassion – fivefold culture. Greatness of friendship and social welfare – individual, family and world peace .

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Course Outcomes

At the end of the course students will be able to:

CO1: Maintain physical wellbeing - grooming, BMI, flexibility, muscle strength, body compositions (vatha, pitha, kapa)

CO2: Maintain mental wellbeing - perceptions, attention/concentration, memory, gunas

CO3: Maintain social wellbeing - etiquettes, emotional and psychological aspects, stress management, morality and values

Text Books

1. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar ,"Value education for harmonious life (Manavalakalai Yoga)", Vethathiri Publications, Erode, I Ed. (2010)

References

1. Dr.R.Nagarathna, Dr.H.R.Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.
2. Dr.R.Nagarathna, Dr.H.R.Nagendra , "New perspectives in stress management", Swami Vivekananda Yoga Prakashana, Bangalore, I Ed June 1986

OPERATIONAL MODALITIES

Orientation programme

Theory and practice demonstration

3 days - 7 hours /day for syllabus coverage

Follow-Up Practice

12 weeks x 2 hours/week: 24 hours

Evaluation:

Continuous evaluation:

Physical Exercises, Kaya kalpa practice, meditation	= 40 marks
Introspection (assessment of students workbook)	= 20 marks
Total	= 60 marks

Semester end examination:

Written test (MCQ and short answers)	= 30 marks
Physical exercises, meditation	= 50 marks
Viva-voce	= 20 marks
Total	= 100 marks

End semester mark out of 100 is reduced to 40 marks

The student should get a total of 50 marks put together for a pass.

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DIMENSIONS AND TOOLS IN MEASUREMENT

Dimension	Sub dimension	Measurement tools
Physical	BMI	Electronic Weighing Machine, Height Measurement
	Flexibility	Sit & Reach
	Muscle Strength	Handgrip Dynamometer
	Prakruti	Dr Ramakrishna's Prakruti Questionnaire
Mental	Perception	Critical Flicker Fusion
	Attention	Digit Letter substitution Test
		Six Letter Cancellation Test
		Stroop Test
	Memory	Digit backward & Forward
Social	Interpersonal Effectiveness & Self Concept	FIRO B
	Psychological Well Being	Short wellbeing scale
		Short Happiness scale
		Barrat Impulsive Scale

END OF SEMESTER- I

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SEMESTER II

Course Code: 16ENT21	**Course Title** : COMMUNICATION SKILLS II (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	**L : T : P : C**	2: 0 :2 : 3
Type: Theory	**Total Contact Hours:**	60 Hours

Prerequisites

The student should have:

- Communication Skills I

Course Objectives

The course is intended to:

1. Listen to monologues or dialogues, comprehend and answer questions.
2. Answer questions about oneself and business-related themes.
3. Read business correspondence, infer and respond to the questions.
4. Write appropriate business e-mail, memo, proposal, report and letter.
5. Write complex sentences.

UNIT I LISTENING **6+6**

Listening to monologues or dialogues and noting specific information - Listening to identify topic, context, and function - Listening for details and main ideas - Gap filling and matching job descriptions and titles.

UNIT II SPEAKING **6+6**

Giving personal information -Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - mini-presentation on a business theme - Giving information and expressing and justifying opinions - discussion on a business-related topic - Expressing and justifying opinions, speculating, comparing and contrasting, agreeing and disagreeing, etc. – negotiating and persuading.

UNIT III READING **6+6**

Reading - skimming for gist and scanning for specific information (Newspaper and magazine articles, reports, advertisements, letters, messages, brochures, guides, manuals) - Reading and understanding text structure – Comprehension – Reading for vocabulary and structure - understanding sentence structure and finding errors.

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UNIT IV WRITING 6+6

Internal written communication - Writing a message, memo or an email: giving instructions, explaining development, asking for comments, requesting information, agreeing to requests - External Communication (e.g. explaining, apologizing, reassuring, complaining), reports (e.g. describing, summarizing) or proposals (e.g. describing, summarizing, recommending, persuading and negotiating).

UNIT V GRAMMAR 6+6

Conditional sentences – Modals and their usage- common errors - Linkers and discourse markers – concord (pronoun and antecedent)

Course Outcomes

At the end of the course students will be able to:

CO1: Listen to monologues or dialogues, comprehend and answer questions equivalent to BEC vantage listening exam.

CO2: Answer questions about oneself and business-related themes on par with BEC vantage speaking exam.

CO3: Read business correspondence, infer and respond to the questions similar to BEC vantage reading exam.

CO4: Write appropriate business e mail, memo, proposal, report and letter on par with BEC vantage writing exam.

CO5: Write complex sentences using appropriate discourse markers.

Text Books

1. Whitby Norman, "Business Benchmark Upper Intermediate Students" Book CUP Publications, 2nd Edition, 2014.

References

1. Cambridge "BEC Vantage - Practice Tests", Self-study Edition, Cambridge University Press, 2002.
2. Hewings Martin, "Advanced Grammar in use - Upper-intermediate Proficiency", Cambridge University Press, Third Edition, 2013.

Web References

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.examenglish.com/BEC/BEC_Vantage.html
- www.splendid-speaking.com/exams/**bec**_speaking.htmlhtml

BoS Chairman

Course Code: 16MAT21	**Course Title** : ENGINEERING MATHEMATICS-II (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	**L : T : P : C**	3: 0 :2 : 4
Type: Theory	**Total Contact Hours:**	75 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics I

Course Objectives

The course is intended to:

1. Determine the solution of second and higher order ordinary differential equations
2. Solve directional derivative, integral theorems.
3. Determine the analytic function and behaviour of conformal mappings
4. Apply the concept of singularities to evaluate integrals.
5. Apply the Laplace transform techniques to solve differential equations

Course Content

UNIT I DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER 9+6

Second and higher order linear differential equations with constant coefficients.Solution by variation of parameters, first order simultaneous differential equations. Applications to Simple Harmonic motion.

UNIT II VECTOR CALCULUS 9+6

Gradient, divergence and curl, irrotational and solenoidal vector fields- Directional derivatives-Green's theorem in a plane (without proof)-Gauss divergence theorem (without proof) - Stoke's theorem (without proof)-evaluation of integrals using Green's, Gauss's and Stoke's theorem.

UNIT III COMPLEX DIFFERENTIATION 9+6

Function of a complex variable-Analytic function -Singular points –Cauchy Riemann equations (without proof) – Properties-Construction of analytic functions. Conformal mapping: w = z+ a, az, 1/z – Bilinear Transformation.

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UNIT IV COMPLEX INTEGRATION 9+6

Cauchy's fundamental theorem (without proof) – Cauchy's Integral formula- Taylor and Laurent expansions- Types of singularity - Residues-Cauchy Residue theorem.

UNIT V LAPLACE TRANSFORM 9+6

Laplace transform-Conditions for existence-Transform of elementary functions- Properties-Transform of derivatives– Transformation of periodic functions-Inverse Laplace transform-Convolution theorem- Solution of linear ODE of second order with constant coefficients using Laplace transform.

Course Outcomes

At the end of the course students will be able to:

CO1: Determine the solution of second and higher order ordinary differential equations using standard techniques
CO2: Solve directional derivative, integral theorems using vector differentiation and integration.
CO3: Determine the analytic function and behaviour of conformal mappings for a complex function
CO4: Apply the concept of singularities to evaluate integrals.
CO5: Apply the Laplace transform techniques to solve differential equations

Text Books

1. Srimanta Pal & Subodh C. Bhunia. "Engineering Mathematics", First edition, 2015, Oxford University Press.
2. Ervin Kreyszig. "Advanced Engineering Mathematics", 10th edition, 2015, Wiley India.

References

1. Peter V. O'Neil. "Advanced Engineering Mathematics", 7th Edition, 2012, Thomson Nelson, Toronto.
2. K.A. Stroud & Dexter J. Booth. "Advanced Engineering Mathematics", 5th Edition, 2011, Palgrave Macmillan.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

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Course Code: 16PHT21	Course Title : MATERIALS SCIENCE (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	L : T : P : C	3: 0 :2 : 4
Type: Theory	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Applied Physics

Course Objectives

The course is intended to:

1. Calculate crystal parameters and analyze different crystal structures.
2. Explain the mechanical, thermal and magnetic properties of bulk materials.
3. Demonstrate the Mechanical and Thermal behaviors of bulk materials.
4. Choose a suitable material for specific application.

UNIT I CRYSTAL STRUCTURE OF MATERIAL PROPERTIES 9

Introduction: Crystalline and Non crystalline Materials: Single crystals, polycrystalline materials, Anisotropy Crystal Parameters: Atomic radius, Number of atoms per unit cell, Co-ordination number, Atomic Packing factor for SC, BCC, FCC and HCP –Crystal Planes: Miller indices, Bragg's law, Debye Scherrer method, Interplanar distance –Polymorphism and allotrophy.Crystal imperfections: Point, line surface and volume, grain boundary and its role in mechanical properties.

UNIT II MECHANICAL PROPERTIES AND TESTING OF MATERIALS 9

Elasticity and plasticity of bulk material, Ductility, malleabililty and brittleness, Stress and strain behavior, Hooke's law, Yield strength, Impact strength, Tensile strength, Resilience, Hardness, Rockwell hardness, Brinell hardness, Vicker's hardness, Micro indentation hardness.Failure of Metals: Fracture behavior, Ductile and Brittle fracture, Toughness, Fatigue- Fatigue fracture-Fatigue test, Endurance limit, SN curve.Creep-Creep fracture-Stages of creep, Creep testing.

UNIT III THERMAL & MAGNETIC PROPERTIES OF MATERIALS 9

Thermal Properties of materials: Introduction to concept of Heat - Thermal Expansion, Thermal conductivity, Thermal diffusivity, Thermal stress, Thermal shock resistance, Thermal stability and Heat resistance - Magnetic Properties of materials: Basic concepts, Diamagnetism, Paramagnetism, Ferromagnetism, Domains and hysteresis, Soft and Hard magnetic materials, applications: motors, generators, and transformers. Antiferromagnetism, Ferrimagnetism, Influence of temperature on magnetic behavior.

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UNIT IV CERAMIC MATERIALS 9

Modern ceramic materials, Cermetsas Cutting tools, Glass ceramics and fibres - Constituents, properties and applications of Diamond, silicon carbide (SiC), zirconia (ZrO_2), Alumina (Al_2O_3), boron carbide (B_4C), and titanium diboride (TiB_2).

UNIT V COMPOSITES 9

Introduction, properties, functions of matrix and reinforcement in composites – Law of mixtures.Classification of composites: Particle-reinforced, Fiber-reinforced and Structural compositesTypes of composite materials: Polymer-matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon composites and Hybrid composite – Aerospace, machinery and sports applications.

Course Outcomes

At the end of the course, the students will be able to:

CO1: Calculate crystal parameters and analyze different crystal structures
CO2: Explain the mechanical, thermal and magnetic properties of bulk materials
CO3: Demonstrate the Mechanical and Thermal behaviors of bulk materials
CO4: Choose a suitable material for specific application

Text Books

1. William D. Callister Jr, "Materials Science and Engineering – An Introduction", John Wiley and Sons Inc., Sixth Edition, New York, 2007.
2. Khanna. O.P "A Text book of Materials Science and Metallurgy", KhannaPublishers, 2003.

References

1. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
2. Vijaya. M.S. and G. Rangarajan, "Material Science", Tata McGraw-Hill, 2007.
3. P.K. Palanisamy, "Material Science for Mechanical Engineers", Scitech Publication (India) Pvt Ltd, 2005.

Web References

- www.nptel.ac.in
- www.ocw.mit.edu

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Materials Science Lab

Any Four Experiments: **15 hrs**

1. Determination of Coercivity, Retentivity, Saturated magnetism and Permeability from Hysteresis loop
2. Determination of Conductivity and Resistivity of samples using Four Probe method
3. Measurement of Melting point of wax with Thermocouple
4. Measurement of mechanical properties of materials using Hardness, Impact and I guard test
5. Determination of Stress strain behavior using Universal Testing Machine.
6. Determination of lattice constants – Debye Scherrer photograph.

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Course Code: 16GET21	**Course Title** : ENGINEERING MECHANICS (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	4: 0 :0 : 4
Type: Theory	**Total Contact Hours:**	60 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics
- Engineering Mathematics - I

Course Objectives

The course is intended to:

1. Construct free body diagram and calculate the unknown force
2. Calculate the magnitude of force acting in each member of frame and machine
3. Calculate the geometric properties of given sections.
4. Analyze the effect of dry friction in contact surfaces
5. Calculate and plot the motion of a particle

UNIT I EQUILIBRIUM OF RIGID BODIES 12

Moment and couple. Free body diagram. Equilibrium conditions applicable to rigid bodies. Varignon's theorem. Moment about point and axis. Problems in equilibrium of rigid body. Beams-types of supports and their reactions-types of forces-method of finding reactions in statically determinate beams.

Introduction to Supports and connections for 3D machine members and their reactions. Problems related to reactions in machine members supported with ball and socket joints only.

UNIT II ANALYSIS OF FRAMES AND MACHINES 9

Introduction - Frames - Machines, Structures containing multi-force members, Analysis of a frame, Analysis of machines.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 15

Properties of surface-centroid, Centroid of simple regular sections using integration (Rectangle, circle and triangle). Method of calculating centroid of composite sections. Problems involving centroid for composite planes such as **L, I, T.**

Moment of inertia for simple sections using integration such as Rectangle, circle and triangle. Parallel and perpendicular axis theorem- concept of polar moment of inertia. Problems involving moment of inertia for composite sections such as T,I,L. Principal MI and principal axis for composite section such as T,I,L.

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Properties of solid geometry - centroid and centre of gravity. Centre of gravity of simple solids. Mass moment of inertia for simple solids. Pappus Guldinus theorem. Relation to area moment of inertia. Problems involving mass moment of inertia for composite solids consist of block, cylinder, cone, and sphere.

UNIT IV FRICTION **12**

Characteristics of dry friction, law of dry friction, theory of friction- free body diagram for equilibrium and impending motion conditions. Equilibrium conditions involving dry friction, problems involving wedge, screw, ladder and flat belt drive. Problems in impending motion condition involving dry friction at some points.

UNIT V DYNAMICS OF PARTICLES **12**

Kinematic parameters - displacement, velocity, acceleration and time. Types of motion-uniform, non-uniform motion, motion of particles in plane - Rectilinear and curvilinear motion of particles-normal and tangential component-motion of projectile- Relative motion-Dependent motion.Kinetics of particles-D'Alemberts principle-works energy and impulse momentum method.

Course Outcomes

At the end of the course, the students will be able to

CO1: Construct free-body diagrams and calculate the unknown forces necessary to ensure static equilibrium condition.

CO2: Calculate the magnitude of force acting in each member of frame and machine under static equilibrium condition.

CO3: Calculate geometric properties such as centroids and moment of inertia

CO4: Analyze the effect of dry friction in contact surfaces (ladder ,wedge, screw and belt)

CO5: Calculate and plot the motion of a particle

Textbooks

1. R.C. Hibbeller, "Engineering Mechanics: Combined Statics & Dynamics", Prentice Hall, 2009
2. F.P. Beer, and Jr. E.R Johnston, "Vector Mechanics for Engineers – Statics and Dynamics", Tata McGraw-Hill Publishing Company, New Delhi, 2012

References

1. James L. Meriam and L.Glenn Kraige, "Engineering Mechanics (Statics and Dynamics)", John Wiley & Sons, 2008.
2. Shames.I.H, and Krishna Mohana Rao.G, "Engineering Mechanics (Statics and Dynamics)", Dorling Kindersley (India) Pvt. Ltd. Pearson Education, 2006.
3. S. Rajasekaran and G. Sankarasubramanian, "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., New Delhi, 2005.

Web References

- http://nptel.ac.in/courses/112103109/
- https://en.wikipedia.org/wiki/Mechanics

BoS Chairman

Course Code: 16GET22	Course Title: ENGINEERING METROLOGY AND MEASUREMENTS (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	L : T : P : C	2: 0 :2 : 3
Type: Theory	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Applied Physics

Course Objectives

The course is intended to:

1. Explain Metrology and Various Measuring Instruments and methods
2. Explain Geometric Dimensioning and Tolerancing (GD&T).
3. Evaluate dimensional accuracy of components.
4. Demonstrate form measurement methods.
5. Describe advanced methods and automation in measurements

UNIT I INTRODUCTION TO ENGINEERING METROLOGY 6

General Concepts of metrology-Importance of metrology-Types of metrology-Dynamic, legal, deterministic-Measurement systems-units, standards, accuracy, precision-dimensional accuracy and precision-Methods of measurement-Sensitivity-Errors in measurements-Method of measurement-various measuring instruments.

UNIT II FORM AND SIZE TOLERANCE 6

Fundamental drawing rules-Tolerance grade and fundamental deviations- Fits, Limits and Tolerances and its needs on CAD/CAM –Datums- Application of datums- Datum feature identification - Cylindrical and Inclined- Form- Flatness, straightness, cylindricity and circularity-Orientation -Angularity, perpendicularity and parallelism –Position- Types of position - Clearance hole, Threaded hole and coaxiality-Concentricity and symmetry – Examples of concentricity and symmetry- Concept of Control Charts, Types of Control Charts, Control Charts for Attributes, p Chart, np Chart, c Chart, u Chart, Control Charts for Variables x Chart, R Chart.

UNIT III LINEAR AND ANGULAR MEASUREMENTS 6

Introduction to linear measurement-Linear measuring instruments-Scale, Vernier, micrometer-types-Gauges-slip gauges, plug gauge, ring gauge, snap gauge-comparators-mechanical, electrical, pneumatic-Introduction to Angular measurement-angular measuring instruments-Sine bar, bevel protractor, autocollimator, angle dekkor.

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UNIT IV FORM MEASUREMENTS 6

Screw thread terminology - Errors in threads - Internal and external screw thread measurements - Screw thread measuring elements - Major diameter, Minor diameter, Pitch diameter & Thread form - Gear terminology - Types of gears - Gear errors - Gear measurement techniques -parkinson gear tester, Autocollimator ,Profile projector - Surface texture -Elements of surface texture - Surface finish methods- Average roughness, Peak to vally, Form factor - Surface finish measuring instruments – Surface Measurement - Roundness Measurements- Temperature: bimetallic strip, thermocouples, electrical resistance thermometer.

UNIT V LASER METROLOGY AND CMM 6

Laser metrology- Laser interferometer - Michelson, Dual frequency, Twyman green, Laser viewers - Types of CMM - Bridge, Cantilever, Horizontal boring mill type, Vertical mill type - Errors in CMM - Application, advantages & disadvantages of CMM - Coordinate Measuring Machine

Course Outcomes

At the end of the course students will be able to:

CO1: Explain Metrology and Various Measuring Instruments and methods
CO2: Explain the Geometric Dimensioning and Tolerancing (GD&T) Principles and Symbol
CO3: Evaluate dimensional accuracy of components using linear and angular measuring instruments
CO4: Demonstrate form measurement methods.
CO5: Describe advanced methods and automation in measurements

Textbooks

1. 1 Gopalakrishna, K. R., "Machine Drawing", 20th Edition, Subhas publishing House, 2007.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005.

References

1. Cencel .H.Jensen and J.D.Helsel, "Engineering Drawing and Design" McGraw Hill Science, 7th Edition, 2007.
2. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005.
3. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications, 2000.

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List of Experiments

30 Hrs

1. Measure the dimensions of the given component using vernier caliper.
2. Determine the diameter of a cylindrical component to accuracy of 0.01mm using micrometer and to check the result with digital micrometer.
3. Measure the height of the machined component using vernier height gauge.
4. Determine the thickness of the ground MS plate using slip gauges.
5. Measure the thickness of gear tooth by using gear tooth vernier and profile projector.

Web References

- http://nptel.ac.in/courses/112106138/
- https://en.wikipedia.org/wiki/Metrology

BoS Chairman

Course Code: 16EPL21	**Course Title** ENGINEERING PRACTICES LABORATORY (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	0: 0 :4 : 2
Type: Practical	**Total Contact Hours:**	60 Hours

Course Objectives

The course is intended to:

1. Demonstrate the basic carpentry, fitting and plumbing operations.
2. Demonstrate the operations of different power tools.
3. Exhibit the proper connection in electrical wiring.
4. Interpret various characteristics of basic electronic components.
5. Demonstrate the installation, formatting and partitioning of computer system.

List of Experiments

1. Make a wooden window frame to the required dimensions with 'T' joint and Dove Tail joint.
2. Make a steel table using fitting process to the required dimensions.
3. Assemble a pipe line from overhead tank to kitchen sink and dining wash basin.
4. Demonstrate the operations of different power tools.
5. a) Make a Domestic wiring circuit to connect a lamp, a fan with regulator and a socket.
   b) Make the internal wiring of a tube light and check the connection.
6. Make a Stair case wiring for controlling a lamp from two different locations.
7. Do the continuity check in the given PCB and rectify the faults.
8. Make an electronic circuit for bi-cycle horn.
9. Install the given OS in the computer system.
10. Do formatting and partitioning of Hard Disk Drive

Course Outcomes

At the end of the course, the students will be able to

CO1: Demonstrate the basic carpentry, fitting and plumbing operations.
CO2: Demonstrate the operations of different power tools.
CO3: Exhibit the proper connection in electrical wiring.
CO4: Interpret various characteristics of basic electronic components.
CO5: Demonstrate the installation, formatting and partitioning of computer system.

References

1. Jeyachandran.K, Natarajan.S & Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, TamilNadu (India), 2007.
2. Rajendra Prasad.A & Sarma.P.M.M.S, "Work shop Practice", Sree Sai Publication, 2002.

BoS Chairman

Course Code: 16CDL21	**Course Title** :COMPUTER AIDED DRAFTING AND MODELING LABORATORY (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	1: 0 :4 :3
Type: Practical	**Total Contact Hours:**	60 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics

Course Objectives

The course is intended to:

1. Develop part and assembly models
2. Prepare production drawing for manufacturing process

UNIT I STANDARDS, SYMBOLS& CONVENTIONS 3

Conventional representation of machine components and materials, Designation of Standard parts - keys, pin joints, fasteners, hexagonal and square head bolts and nuts, conventional representation of threads. BIS codes for practice of Machine Drawing - Dimensioning, abbreviations and conventions, welding symbols, surface finish symbols, screws, bolts, nuts and rivets.

UNIT II CAD SOFTWARE FEATURES 3

Capabilities of CAD software - Parametric modeling-Concepts, 3D software packages features-reference planes – 2D sketching tools - relationships and constraints –part modelling tools – extrusion, revolve, sweep – modifying tools

UNIT III DEVELOPMENT OF PART AND ASSEMBLY MODELS 3

Drawing front view, top view and side view of objects from the given pictorial views. Preparation of 2-D drawings of standard machine elements.-Assembly tools features of modelling software. Creation of assembly models with functional features.

UNIT IV PART DRAWING OF MACHINE COMPONENTS 3

Create part drawing using CAD software with manufacturing considerations. Exercise on bolt & nut (square and hexagon), studs and washers. Exercise on different types of keys, screws, spring etc.

BoS Chairman

UNIT V PRODUCTION DRAWING 3

Preparation of Production drawing - Multiple views of part modelsand machine components –Bill of materials - Drawing Layout.

List of Experiments **45 Hrs**

1. Preparation of isometric view for the orthographic views of simple parts
2. Exercise on square, hexagonal bolt and nuts
3. Exercise on different types of keys
4. Exercise on screws , rivets and springs
5. Preparation of part drawing - aluminum wheel.
6. Preparation of part drawing - support bracket
7. Preparation of part drawing -sheet metal guard
8. Preparation of Assembly drawing - castor wheel
9. Preparation of production drawing -aluminum wheel assembly

Course Outcomes

At the end of the course the student will be able to

CO1: Develop part and assembly models using CAD Software.
CO2: Prepare production drawing for manufacturing process using CAD software

References

1. Gopalakrishna, K. R., "Machine Drawing", 20th Edition Subhas publishing House,2007.
2. Cecil Jensen, Jay D. Helsel, Dennis R. Short , "Engineering Drawing & Design", 7th edition McGraw-Hill Higher Education. 2007

BoS Chairman

Course Code: 16PSL21	Course Title : SPORTS FOR WELLNESS (Common to all B.E/B.Tech Programmes)	
Core/Elective: Core	L : T : P : C	0: 0 :2 :1
Type: PS	Total Contact Hours:	30 Hours

Prerequisites:

The student should have undergone the course(s):

- Promotion of Students Wellness

Course Objectives

The course is intended to:

1. Explain the significance of physical fitness.
2. Maintain physical fitness.
3. Exhibit mental agility.

UNIT I HEALTH 6

Meaning of health - Components of health - physical, mental, social, emotional, spiritual - importance of health - Personal hygiene - Heredity and environment –Adopting healthy habits

UNIT II FITNESS & WELLNESS 6

Fitness and wellness – what is physical fitness - categories - components of health related physical fitness- components of skill related physical fitness-values of physical fitness – Physical fitness development.
What is wellness - importance of wellness for engineers –factors promoting wellness – Physiology and health : cardio-respiratory, muscular and nervous systems – ageing

UNIT III FOOD & HEALTH 6

Energy balance and body composition – nutrients- problems of surplus and deficiency-balanced diet - good food habits for better health – hazards of junk food - food and the gunas.

UNIT IV FITNESS & DEVELOPMENT I 6

Exercises related ailment and injuries - safety and precautions - first aid.
Muscular strength – exercises (calisthenics): pull-up, sit-up, push-up and weight training.
Explosive power – exercises: vertical jump, long jump,
Cardio respiratory endurance– exercises: walking, jogging, treadmill, stair climbing, bicycling, skipping.
Flexibility –exercises: stretching

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UNIT V FITNESS & DEVELOPMENT II 6

Speed, agility, balance and coordination – exercises: sprint, cone drill, ladder drill, hurdle drill, ball throw - mental agility tests.
Dexterity - 12 minutes cooper test – long run – adventure games
Team games.

Course Outcomes

At the end of the course, the students will be able to:

CO1: Explain the significance of physical fitness for healthy living
CO2: Maintain physical fitness through exercises
CO3: Exhibit mental agility

References

1. Tony Buzan, Harper Collins, "The Power of Physical Intelligence", Thorsons Publications 2003.
2. Student reading material and workbook prepared by PS team of the college.

OPERATIONAL MODALITIES:

Orientation programme

Special lectures by invited resource persons at semester beginning
3 lectures x 4 hours = 12 hours

Follow-up practice

12 weeks x 2 hours/week = 24 hours

Evaluation

Continuous evaluation:

Physical Exercises	= 40 marks
Assessment of students workbook	= 20 marks
Total	= 60 marks

Semester end examination:

Written test (MCQ and short answers)	= 30 marks
Physical exercises	= 50 marks
Viva-voce	= 20 marks
Total	= 100 marks

End semester mark out of 100 is reduced to 40 marks
The student should get a total of 50 marks put together for a pass.

MEASUREMENTS:

At the Beginning + At Semester End

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SCHEDULE OF EXERCISES FOR STUDENTS WITH DIFFERENT PHYSICAL CONDITIONS

Underweight	Normal	obese
Flexibility exercises - stretching	Flexibility exercises - stretching	- Brisk walking
Minor games -forward running relay -backward running relay - over&under relay -circle games, etc.	-Walking - Walking-cum-jogging	- Minor games
Strength Training - Calisthenics	Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling - long distance running	flexibility exercises - stretching - Cycling (static)
Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling	Agility - ladder drills - hurdle drill - cone drill	Cardio/Functional Fitness Skipping Jogging bicycling
Agility exercises - ladder drills - hurdle drill - cone drill	Strength Training -Calisthenics -gym workout for major muscles	Strength Training - Calisthenics - gym workouts
Diet Considerations	Diet considerations	Diet considerations
Measurements		
BMI Hand grip strength test 12 m Cooper run Sit & reach	BMI 12 m Cooper run Sit & reach test Illinois agility test	BMI Body fat percentage Waist-to-hip ratio Sit&reach

END OF SEMESTER- II

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BoS Chairman

SEMESTER III

Course Code: 16MAT31	**Course Title:** TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: General	**L : T : P : C**	3: 2 : 0 : 4
Type: Theory & Tutorial	**Total Contact Hours:**	75 Hours

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mathematics II

Course Objectives

The course is intended to:

1. Determine the solution of first and second order partial differential equations.
2. Compute the Fourier series expansion for given periodic function.
3. Compute the solution of one dimensional wave equation.
4. Compute the solution of one dimensional and two dimensional heat flow equation.
5. Calculate the Fourier transformation for aperiodic function.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+6

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations – Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+6

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity –Complex form of Fourier series- Harmonic analysis.

UNIT III SOLUTION OF ONE DIMENSIONAL WAVE EQUATION 9+6

Method of separation of variables - Classification of second order linear partial differential equations, Solutions of one dimensional wave equation by Fourier series method.

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UNIT IV SOLUTION OF ONE AND TWO DIMENSIONAL HEAT FLOW EQUATION 9+6

One dimensional equation of heat conduction - Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded), Solution by Fourier series method.

UNIT V FOURIER TRANSFORM 9+6

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Course Outcomes

At the end of the course students will be able to:

CO1: Determine the solution of first and second order partial differential equations for homogeneous and non-homogeneous types.
CO2: Compute the Fourier series expansion for given periodic function using Euler's formula.
CO3: Compute the solution of one dimensional wave equation to represent the vibrating string using Fourier series method.
CO4: Compute the solution of one dimensional and two dimensional heat flow equation using Fourier series method.
CO5: Calculate the Fourier transformation for aperiodic function using Fourier Integral theorem.

Text Books

1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, First Edition, Oxford University Press, New Delhi, 2015
2. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publications, 2015.

References

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012
2. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Publications Pvt Ltd, 2011.
3. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Web References

- http://nptel.ac.in/courses/122107037/19
- http://nptel.ac.in/video.php?subjectId=108106075

BoS Chairman

Course Code: 16PET31	Course Title: FOUNDRY TECHNOLOGY	
Core/Elective: Core	L : T : P : C	3 : 0: 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Material Science
- Engineering Metrology and Measurements

Course Objectives

The course is intended to:

To understand the principle, procedure and applications of various foundry processes

1. Explain Principle, procedure & application of various casting processes
2. Explain the casting metallurgy of Pure and alloy material
3. Choose appropriate design of gating system.
4. Describe recent trends in casting and foundry layout.
5. Explain testing of casting

UNIT I CASTING PROCESS 10

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes

UNIT II CASTING METALLURGY 8

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III DESIGN OF GATING SYSTEMS 10

Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends. Chvorinov's Rule Riser design; risering curves; NRL method of riser design; feeding distance; risering of complex casting;

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UNIT IV RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT V TESTING OF CASTINGS 9

Causes and remedies for casting defects –Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic cell – studies in testing of joints & castings. Methods of elimination and control of dissolved gases in castings. use of statistical quality control in foundry.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain operation of different casting Process.
CO2: Explain the casting metallurgy of Pure and alloy material.
CO3: Explain the design of gating system.
CO4: Explain the recent trends in casting and foundry layout.
CO5: Describe different testing method to study the defect in the casting

TEXT BOOKS:

1. Jain P.L.,Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
2. Principle of metal casting – Heime, Looper and Rosenthal – Tata McGraw Hill – 2001

REFERENCES

1. Taylor H.F., Fleming.M.C.,, "Foundry Engineering" M.C. & Wiley Eastern Ltd., 1993
2. ASM Handbook, Vol 15, Casting, 2004

Web References

- nptel.ac.in/courses/112107144/13

BoS Chairman

Course Code: 16PET32	**Course Title:** STRENGTH OF MATERIALS (End Semester Theory Exam common to 16MET41)	
Core/Elective: Core	**L : T : P : C**	2 : 2 : 0 : 3
Type: Theory & Tutorial	**Total Contact Hours:**	60 Hours

Prerequisites

The student should have undergone the course:

- Engineering Mechanics

Course Objectives:

The course is intended to:

1. Calculate the stresses, strains and elastic constants
2. Solve problems on two dimensional stresses
3. Sketch shear force and bending moment diagrams and calculate stresses in beams.
4. Compare deflections beams and stability of columns.
5. Solve problems on circular shafts and close coil helical springs.

UNIT I STRESS AND STRAIN OF SOLIDS **12**

Rigid body and deformable body, Stiffness - types of stresses and strains-stresses in simple and compound bars under axial load- factor of safety- Poisson's ratio- elastic constants - Modulus of Elasticity- bulk Modulus- modulus of rigidity-Relationship between elastic constants- temperature stress and strain- Strain energy(concept only).

UNIT II STRESSES IN TWO DIMENSIONS **12**

Stresses on inclined planes-principal planes and stresses-Mohr's circle for biaxial stresses (Concepts only).Thin wall pressure vessel and it types- The Longitudinal Stress - Hoop stress - application - Stresses and Strain in cylindrical thin shells.

UNIT III BEAMS - LOADS AND STRESSES **12**

Beam- Types of beams- transverse loads and its types- Shear force and bending moment - cantilever simply supported beams and overhanging beams (simple problems only).

Theory of simple bending - bending equation – bending stress -Neutral axis – transverse shear stress - shear stress for I section and T section of beams.

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UNIT IV DEFLECTION OF BEAM AND COLUMN 12

Deflection beams- Moment Area method, Double integration method. Failure of a column-Euler's Column Theory - Limitation of Euler's formula- End conditions for long columns- Effective length-Slenderness Ratio- Rankine's formula.

UNIT V TORSION OF SHAFTS AND SPRINGS 12

Torsion- assumptions in the theory of pure torsion- torsional rigidity – torque transmitted by a solid and hollow bar of circular cross section- torque transmitted by a stepped shaft - torque transmitted by a compound shafts. Springs and its types- closed coil Helical springs subjected to compressive loads

Course Outcomes

At the end of the course students will be able to:

CO1: Calculate the normal stresses, strains and elastic constants of structural member subjected to external loading such as axial loads and thermal loads in one dimensional member such as bar.

CO2: Solve two dimensional stresses such as normal, shear, hoops and longitudinal on the bar element and thin cylindrical pressure vessel.

CO3: Articulate shear force and bending moment diagrams for cantilever simply supported beams and overhanging beams and stresses in beam structures subjected to transverse loading.

CO4: Analyse deflections of cantilever and simply supported beams and stability of short and long columns using Euler's formula and Rankine's Formula

CO5: Calculate shear stress, torsional rigidity, diameter required and deflection on circular shafts subjected to torsion and close coil helical springs subjected to compressive load.

Text Books

1. Hibbeller RC, "Mechanics of Materials", Prentice-Hall of India, New Delhi, 2013.
2. James M Gere, " Mechanics of Materials", Cengage Learning, India, 2012.

References

1. Rattan SS "Strength of Materials" Tata McGraw-Hill Education Pvt Ltd., New Delhi, 2011.
2. Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.
3. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.

Web References

- http://nptel.ac.in/courses/112107147/

BoS Chairman

Course Code : 16MET31	Course Title: ENGINEERING METALLURGY (Common to Production & Automobile)	
Core/Elective: Core	L : T : P : C	2: 0 : 2 : 3
Type: Theory & Practical	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course:

- Material Science

Course Objectives

The course is intended to:

1. Analyze a phase diagram.
2. Select an appropriate heat treatment process
3. Select an appropriate surface treatment process
4. Choose an appropriate alloying element to impart a desired property for ferrous alloys
5. Choose an appropriate alloying element to impart a desired property for non-ferrous alloys

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 6

Constitution of alloys- Solid solutions- Substitutional and Interstitial. Phase diagrams- Interpretation of Phase diagram, Lever rule, Gibbs phase rule. cooling curve for pure metal, binary solid solution and binary eutectic system. Iron – Iron Carbide equilibrium diagram. Micro constituents in Fe_3C diagram (Austenite, Ferrite, Cementite, Pearlite, Martensite, Bainite), Pearlite transformation.

UNIT II HEAT TREATMENT 6

Heat treatment process-purpose heat treatment. Types of heat treatment: Full Annealing, Process annealing, Stress relief annealing, Speroidising, Isothermal annealing, Normalizing , Hardening, Tempering of steel-Low tempering, medium tempering, high tempering. Austempering and Martempering. Quenching and quenching media. Isothermal transformation Diagram (TTT Diagram). Cooling curves superimposed on TTT diagram.CCR. Harden ability- Definition. Method to determine Harden ability- Jominy end quench test. Ideal Critical diameter.

UNIT III SURFACE HEAT TREATEMENT PROCESS 6

Surface treatment process – Purpose of surface treatment . Case hardening- Carburizing- types –Pack carburizing Liquid carburizing, Gas carburizing, Nitriding, Cyaniding, Flame and Induction hardening-working principle, merits, demerits and applications.

BoS Chairman

UNIT IV FERROUS ALLOYS 6

Ferrous metals - Definition. Steel - Types (Low carbon, medium carbon and High carbon steels). Effect of alloying elements on properties of steel (Ms, Si, Cr, Mn, Va and W). Properties and applications of Stainless Steel and Tool steel. HSLA steels-Maraging steels. TRIP steels. Cast Iron-Types - White, Malleable, Grey and Spheroidal – Microstructure, properties and applications.

UNIT V NON-FERROUS ALLOYS 6

Non-ferrous metals – Types – Aluminium and its alloys -Designation system, Copper and its alloys, Nickel and its alloys Magnesium and its alloys, Titanium and its alloy – Composition, Properties, Applications,

Course Outcomes

At the end of the course students will be able to:

CO1: Analyze the phase diagram of an alloy by Gibbs phase rule and infer its property for a given composition.

CO2: Select an appropriate heat treatment process to impart a desired property for a given ferrous alloy such as steel, cast iron and determine its harden ability

CO3: Select an appropriate surface treatment process for ferrous and non-ferrous alloys to improve its surface hardness..

CO4: Choose an appropriate alloying element to impart a desired property for a given ferrous alloy such as steel and cast iron..

CO5: Choose an appropriate alloying element to impart a desired property for a given nonferrous alloy such as Aluminium , Copper , Nickel, Magnesium and Titanium.

Text Books

1. William D Callister "Material Science and Engineering", John Wiley and Sons, 2014.
2. AnupGoel, SSSabharwal, "Engineering Materials and Metallurgy", Technical Publication, 2014.

References

1. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2015.
2. Dieter G. E., "Mechanical Metallurgy", McGraw Hill Book Company, 2013
3. Sydney H. Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2008.

BoS Chairman

Laboratory

List of Experiments: **30 Hrs**

1. Prepare a specimen using mounting press for metallographic examination.
2. Draw the microstructure of cast iron, steel and aluminum using Metallurgical microscope
3. Compare the hardness number and impact strength for unhardened, hardened and tempered mild steel specimens
4. Determine the hardenability of steel by Jominy End Quench

Web References

- http://nptel.ac.in/courses/113106032/
- http://www.nptel.ac.in/courses/112108150/
- https://en.wikipedia.org/wiki/Materials_science

BoS Chairman

Course Code:16PET33	Course Title: THEORY OF MACHINES	
Core/Elective: Core	L : T : P : C	3 : 0 : 2 : 4
Type: Theory & Practical	Total Contact Hours:	75 Hours

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mechanics

Course Objectives

The course is intended to:

1. Calculate the DOF of simple mechanisms.
2. Calculate the kinematic parameters of simple mechanisms.
3. Calculate the static and dynamic forces for equilibrium of mechanisms
4. Develop cam profile
5. Calculate the kinematic parameters of gears and gear trains

UNIT I BASICS OF MECHANISMS 9

Mechanism, Machine, Structure, Constrained motion, and its types. Kinematic link, Kinematic pair and their types. Working of simple mechanism such as four bar mechanism, slider crank mechanism and their respective inversions. Kutzbach criterion, Grubler's criterion and Grashof's law. Degrees of Freedom (DoF), Transmission angle, Mechanical advantage.

UNIT II KINEMATIC ANALYSIS 9

Linear, angular, absolute and relative velocities. Rubbing velocity, Tangential and radial and coriolis components of acceleration. Relative velocity method for determination of velocity and acceleration of the links four bar and slider crank mechanisms. Analytical expressions for the position, velocity and acceleration of the links in slider crank mechanism

UNIT III STATIC AND DYNAMIC FORCE IN MECHANISMS 9

Applied and constrained forces, D' Alembert's principle, Static equilibrium conditions of Two and three force members, Problems in static force analysis, Inertia force and Inertia torque, Governors and Gyroscopic effects

Dynamic analysis in reciprocating engine- Gas forces, Bearing loads, Turning moment diagrams, Flywheels, Coefficient of fluctuation of Energy and speed, mass of flywheel required.

BoS Chairman

UNIT IV KINEMATICS OF CAM 9

Types of cams - Types of followers - Radial cam -Terminology of radial cam - Types of follower motions- uniform velocity motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion. cam profile for knife edge, roller, flat faced follower- Graphical Methods

UNIT V KINEMATICS OF GEARS AND GEAR TRAINS 9

Gear - Types and profile, nomenclature of spur & helical gears, laws of gearing Conjugate action and conjugate curves, merits and demerits of involute and cycloidal profiles, The path of approach, Recess, length of path of contact, length of arc of contact. - contact ratio, interference and undercutting - Derivation for the Minimum numbers of teeth on the pinion to avoid Interference - Classification of gear trains, calculation of velocities of Simple, Compound, Epicyclic & Reverted gear trains (tabulation method only).

Course Outcomes

At the end of the course students will be able to:

CO1: Calculate the DOF, given the kinematic diagram or the real world picture of planar mechanisms.

CO2: Calculate the position, velocity and acceleration parameters of the given simple mechanism using graphical method.

CO3: Calculate the static and dynamic forces for equilibrium of the given a slider crank or a four bar mechanism

CO4: Develop the radial cam profile for the given type of follower and motion function.

CO5: Calculate the kinematic parameters of spur gear and velocity ratio of simple, compound and epicyclic gear trains.

Text Books

1. Ambekar A. G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. Rattan S S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2014.

References

1. UickerJ.J.Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms"(Indian Edition), Oxford University Press, 2010.
2. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005.
3. Sadhu Singh, "Theory of Machines", Pearson Publishers, 2012.

BoS Chairman

Laboratory

List of Experiments **30 Hrs**

1. Draw models and simulate the following mechanisms:
    a. Four bar mechanisms
    b. Double rocker mechanism
    c. Crank rocker mechanism
    d. Double crank mechanism
    e. Slider crank mechanism
2. Perform an experiment on the Cam follower setup and plot the follower displacement against the crank rotation.
3. Do a study of differential gear train setup, identify the different gears and draw a neat sketch of the gear train
4. Perform an experiment on the compound gear train setup and calculate the velocity ratios based on i) revolutions and ii) number of teeth of the gears

Web References

- http://nptel.ac.in/courses/112104121/1

BoS Chairman

Course Code: 16PET34	Course Title: BASIC ENGINEERING THERMODYNAMICS	
Core/Elective: Core	L : T : P : C	2 : 2 : 0 : 3
Type: Theory & Tutorial	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Applied Physics

Course Objectives

The course is intended to:

1. Apply the first and second laws of thermodynamics to the analysis of complete thermodynamic systems
2. Calculate the thermodynamic characteristics of IC engines
3. Calculate the performance of Rankine cycle.
4. Calculate the performance characteristics of reciprocating and rotary air compressors
5. Explain refrigeration and air-conditioning systems using psychometric chart.

UNIT I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 12

Classical approach: Thermodynamic systems – Control volume - System and surroundings – Universe – Properties - State-process – Cycle – Equilibrium - Work and heat transfer – Point and path functions - First law of thermodynamics for open and closed systems - First law applied to a control volume - SFEE equations [steady flow energy equation] - Second law of thermodynamics - Heat engines - Refrigerators and heat pumps - Carnot cycle - Carnot theorem. (qualitative treatment only).

UNIT I IC ENGINES 12

Air standard cycles: Otto, diesel and dual cycles and comparison of efficiency - Working Principle of four stroke and two stroke engines - Working principle of spark ignition and compression ignition engines - Application of IC engines.

UNIT III PROPERTIES OF PURE SUBSTANCE AND VAPOR POWER CYCLES 12

Phase rule, properties of pure substance (water) in three phases - P-V diagram, T-S diagram, H-S diagram, P-V-T surface. thermodynamic properties of steam. Vapor power cycles- steam rate, heat rate, efficiency calculation of Rankine Cycle, Reheat cycles and Regenerative cycle (qualitative treatment only).

BoS Chairman

UNIT IV COMPRESSORS 12

Positive displacement compressors – Reciprocating compressors – Indicated power – Clearance volume – Various efficiencies – Clearance ratio – Volume rate – Conditions for perfect and imperfect intercooling – Multi stage with intercooling – Rotary positive displacement compressors – Construction and working principle of centrifugal and axial flow compressors. (qualitative treatment only).

UNIT V REFRIGERATION & AIR CONDITIONING 12

Refrigeration - Various methods of producing refrigerating effects (RE) – Vapour compression cycle: P-H and T-S diagram - Saturation cycles - Airconditioning systems – Basic psychrometry - Simple psychrometric processes - Types of airconditioning systems - Selection criteria for a particular application (qualitative treatment only).

(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

Course Outcomes

At the end of the course students will be able to:

CO1: Apply the first and second laws of thermodynamics to the analysis of complete thermodynamic systems.
CO2: Calculate the thermodynamic characteristics of IC engines using air-standard cycles.
CO3: Calculate the performance of Rankine cycle by calculating the thermal efficiencies of the cycle.
CO4: Calculate the performance characteristics of reciprocating and rotary air compressors by calculating the efficiencies of the cycle.
CO5: Explain refrigeration and air-conditioning systems using psychrometric chart.

Text Books

1. S.Domkundwar, C.P.Kothandaraman & A.V. Domkundwar, "Thermal Engineering", Dhanpat Rai & Co. 2016.
2. Cengel, "Thermodynamics – An Engineering Approach" 3rd Edition ,Tata McGraw Hill, New Delhi, 2015.

References

1. Holman.J.P., "Thermodynamics", 3rd Edition McGraw-Hill, 1995.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1994
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

Web References

- http://nptel.ac.in/courses/112105123/1
- https://en.wikipedia.org/wiki/Thermodynamics

BoS Chairman

Course Code: 16PEL31	**Course Title:** STRENGTH OF MATERIALS LABORATORY	
Core/Elective: Core	**L : T : P : C**	0 : 0 : 4 : 2
Type: Practical	**Total Contact Hours:**	60 Hours

Course Objectives

The course is intended to:

1. Conduct experiments and calculate the different mechanical properties

List of Experiments

1. Conduct tension test on the given mild steel rod using universal testing machine for determining the yield stress, ultimate stress, breaking stress, percentage of reduction in area and percentage of elongation over a gauge length and Young's modulus.
2. Conduct shear test on Mild steel and Aluminum rods by Double shear.
3. Calculate the modulus of rigidity of mild steel rod by Torsion test.
4. Determine the toughness of the given mild steel specimen using IZOD and CHARPY impact test.
5. Determine the Hardness Number of metals by Brinell and Rockwell Hardness tester.
6. Determine the flexural rigidity of given rectangular beam.
7. Estimate the stiffness and modulus of rigidity of the helical spring by Compression test.

Course Outcomes

At the end of the course students will be able to:

CO1: Conduct experiments and calculate the different mechanical properties of the given specimen.

BoS Chairman

Course Code: 16PEL32	Course Title: MANUFACTURING PROCESSES LABORATORY	
Core/Elective: Core	L : T : P : C	0 : 0 : 4 : 2
Type: Practical	Total Contact Hours:	60 Hours

Course Objectives

1. Produce a casted part.
2. Produce a welded part.
3. Produce a forged part.
4. Produce a sheet metal part.

List of Experiments

1. Preparation of sand mould for single piece pattern
2. Preparation of sand mould for split pattern
3. Casting of Aluminum wheel
4. Manual Metal Arc welding of Butt joint
5. Manual Metal Arc welding of T- Joint
6. Welding of support bracket
7. Forging of round rod to square rod
8. Forging of wheel shaft -Upsetting of pin head
9. Fabrication of sheet metal tray
10. Fabrication of sheet metal guard for the wheel

Course Outcomes

At the end of the course students will be able to:

CO1: Make a cast component using sand /die casting process for the given design requirement

CO2: Make a welded component using arc welding for the given design requirement

CO3: Make a forged component by hand forging process for the given design requirement

CO4: Make a sheet metal component by forming process for the given design requirement

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Course Code: 16PSL31	**Course Title:** PERSONAL EFFECTIVENESS (Common to all B.E/B.Tech Programmes)	
Core/Elective: General	**L : T : P : C**	0 : 0: 2 : 1
Type: PS	**Total Contact Hours:**	30 Hours

Course Objectives

1. Identify the strengths, weaknesses and opportunities
2. Set goals for academics, career, and personal aspirations
3. Establish the road map for goals
4. Apply time management techniques
5. Create time and pursue activities of self-interest

Course Content

UNIT I THE IMPORTANCE OF ENVISIONING

Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people – Importance of goal setting –Importance of planning and working to time

UNIT II FUNDAMENTAL PRINCIPLES OF GOAL SETTING AND WORKING TO TIME

Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume.

UNIT III GOAL SETTING AND ACTION ORIENTATION

Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress

UNIT IV TIME MANAGEMENT - TOOLS AND TECHNIQUES

Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination

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UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly work journal – Executing and achieving short term goals – Periodic reviews

Course Outcomes

At the end of the course the student will be able to:

CO1: Identify one's strengths, weaknesses and opportunities

CO2: Set well-articulated goals for academics, career, and personal aspirations

CO3: Establish the road map to realize the goals

CO4: Apply time management techniques to complete planned tasks on time

CO5: Create time and pursue activities of self-interest that add value

Course handouts (compiled by PS team, MCET)

1. Learner's workbook
2. Personal efficiency Journal
3. Reading material for Personal Effectiveness

Further Reading

1. Stephen R Covey, "First things first", Simon & Schuster Uk, Aug 1997.
2. Sean Covey, "Seven habits of highly effective teenagers", Simon & Schuster Uk, 2004.

END OF SEMESTER- III

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SEMESTER IV

Course Code: 16MAT41	**Course Title:** NUMERICAL METHODS (Common to Production, Mechatronics, Automobile & Mechanical)	
Core/Elective: Core	**L : T : P : C**	3 : 2 : 0 : 4
Type: Theory & Tutorial	**Total Contact Hours:**	75 Hours

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mathematics II
- Engineering Mathematics III

Course Objective

The course is intended to:

1. Determine the solution of linear equations and calculate the dominant Eigen value
2. Determine the solution of non-linear equations and fit a curve for the given data.
3. Determine the unknown values, derivatives and integrals from the given data
4. Compute the solution of first order ordinary differential equations.
5. Compute the solution of partial differential equations.

UNIT I SOLUTION OF SYSTEM OF LINEAR EQUATIONS 9+6

Solution of system of linear equations-Direct method: Gaussian elimination method, Choleski method, Iterative methods: Gauss-Seidel - sufficient conditions for convergence. Power method to find the dominant Eigen value and the corresponding Eigen vector.

UNIT II SOLUTION OF NON-LINEAR EQUATION & CURVE FITTING 9+6

Solution of non-linear equation: Method of false position - Newton- Raphson method -Order of convergence of these methods. Curve fitting - Method of least squares.

UNIT III INTERPOLATION, NUMERICAL DIFFERENTIATION & INTEGRATION 9+6

Newton's forward, backward interpolation – Lagrange's interpolation. Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 rule – Gaussian

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two point and three point quadrature formula –Double integration using Trapezoidal rule.

UNIT IV SOLUTION OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

9+6

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series- Euler's method - Runge-Kutta method of fourth order – Multi step method: Adams' method.

UNIT V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 9+6

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method.

Course Outcomes

At the end of the course, the students will be able to

- CO1: Determine the solution of linear equations and calculate the dominant Eigen value using standard techniques.
- CO2: Determine the solution of non-linear equations and fit a curve for the given data.
- CO3: Determine the unknown values, derivatives and integrals from the given data using numerical techniques.
- CO4: Compute the solution of first order ordinary differential equations using numerical techniques.
- CO5: Compute the solution of partial differential equations using numerical techniques.

Text Books

1. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", First Edition, Oxford University Press, New Delhi, 2015.
2. Grewal, B.S. and Grewal, J. S., "Numerical Methods in Engineering and Science", Sixth Edition, Khanna Publishers, New Delhi, 2004.

References

1. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.
2. Jain M. K., Iyengar, S. R. and Jain, R. K, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Company.
3. Sastry.S.S "Introductory Methods of Numerical Analysis", 3rd Edition, PHI, 2003

Web References

http://nptel.ac.in/courses/122102009/

BoS Chairman

Course Code: 16EET45	**Course Title:** ELECTRICAL DRIVES AND CONTROLS (Common to Production & Mechanical)	
Core/Elective: Core	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Course Objective

The course is intended to:

1. Explain an electrical drives and its control
2. Explain the characteristics of DC drives with different control techniques
3. Explain the characteristics of AC drives with different stator side control.
4. Explain the operating principle of special electrical drives
5. Choose an electrical drive for an applications

UNIT I INTRODUCTION **9**

Fundamentals of electric drives - characteristics of loads – different types of mechanical loads – four quadrant operation of electric drive- control circuit components: Fuses, circuit breakers, contactors, relays

UNIT II SPEED CONTROL OF DC MACHINES **9**

Constructional features and working principle of a DC machine - Speed Torque characteristics of DC shunt & series motor – Methods of Speed control - Solid state DC drives: bridge rectifier fed DC drives, Chopper fed DC drives, Static Ward Leonard method.

UNIT III SPEED CONTROL OF AC MACHINES **9**

Constructional details of induction motors – Types of rotors – Principle of operation – Slip - Speed torque Characteristics of Induction motors – speed control using: pole changing, stator frequency variation, stator voltage variation - basic inverter fed induction motor drive - variable voltage variable frequency drive.

UNIT IV SPECIAL ELECTRICAL DRIVES & CONTROLS **9**

Stepper motor: Constructional and working – applications -BLDC motor : Constructional and working – applications – encoders - AC and DC Servo Motor : Constructional and working – applications.

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UNIT V CONTROL AND SELECTION OF ELECTRIC DRIVES 9

Microcontroller, PLC & PC based control - Selection of an electric drive –IP classes - insulation testing and classes of electric motors - SF motors - continuous,intermittent and short time duty – Selection of drive for home appliances, machine tools, automobile applications, locomotives and steel rolling mills.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain an electrical drives and its control to operate in different modes.
CO2: Explain the characteristics of DC drives with different control techniques such as field and armature control.
CO3: Explain the characteristics of AC drives with different stator side control.
CO4: Explain the operating principle of special electrical drives such as stepper, BLDC and servo drive.
CO5: Choose an electrical drive for an application such as residential and industrial.

Text Books

1. N.K De and P.K Sen "Electric Drives" Prentice Hall of India Private Ltd.,2012.
2. VedamSubramaniam "Electric Drives" Tata McGraw Hill, New Delhi, 2010.

References

1. Bhattacharya Brinjinder Singh S.K, "Control of Electrical Machines" New Age International Publishers, 2006.
2. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2013.
3. Krishnan R, "Electric motor drives Modeling, analysis and control", Pearson Education, New Delhi, 2003.

Web References

- http://nptel.ac.in/courses/108108077/
- https://en.wikipedia.org/wiki/Solid-state_drive
- nptel.ac.in/syllabus/108104011/

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Course Code: 16MET42	**Course Title:** METAL CUTTING PROCESSES (Common to Production & Mechanical)	
Core/Elective: Core	**L : T : P : C**	3 :0: 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course:

- Metal Forming , Joining and Casting Processes
- Material Science

Course Objectives

The course is intended to:

1. Explain the basic principles involved in metal cutting process.
2. Select appropriate metal cutting processes to manufacture a cylindrical part.
3. Select appropriate metal cutting operations to manufacture a prismatic a part.
4. Select appropriate metal finishing processes for the given design requirement
5. Develop part programme using Computer Numerical Control machines.

UNIT I THEORY OF METAL CUTTING 9

Metal removal processes, Orthogonal cutting, Oblique cutting, Cutting tools, Tool geometry of single point cutting tool, Types of chips, Cutting tool – Characteristics, materials, Mechanics of orthogonal cutting, Machinability, Tool life using Taylors equation, Types of tool wear, Cutting fluids – Functions, types

UNIT II MACHINING CYLIDRICAL FEATURES 9

LATHE

Centre lathe - Constructional Features, Parts, Operations performed, Attachments/Accessories, Process parameters, Capstan lathe and Turret lathe, Types of automatic lathes, Turret indexing mechanism, Bar feeding mechanism, semi-automatic and automatic lathes, Tooling layout.

DRILLING

Constructional features of drilling machine, upright drilling machine, radial drilling machine, Operations, Process parameters.

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UNIT III MACHINING PRISMATIC COMPONENTS WITH MILLING MACHINES 9

Milling machines - Types, Constructional features. Milling cutter - Types, nomenclature. Up milling & Down milling, Operations performed in milling machine, Process parameters.

UNIT IV METAL FINISHING PROCESSES 9

Grinding: Types of grinding machines, Types of grinding wheels, Grinding wheel designation, Classification of grinding machines and grinding wheels, Constructional features of cylindrical grinding machines, Surface grinding machines, Process parameters.

Honing, Types of honing, Lapping, Types of lapping (Equalising, form), Types of lapping machines, Burnishing, Polishing and Buffing. – Process and Application

UNIT V CNC MACHINING 9

CNC Machines- Fundamentals, Constructional features. Machining centre, Part programming fundamentals – manual part programming.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the basic principles involved in manufacturing a part by metal cutting process.

CO2. Select appropriate metal cutting processes to manufacture a cylindrical part which involve Lathe, Automat and Drilling machines.

CO3. Select appropriate metal cutting operations to manufacture a prismatic a part which involve Milling machines.

CO4. Select appropriate metal finishing processes which involve grinding, honing, burnishing and lapping for the given design requirement

CO5. Develop part programme for producing a part using Computer Numerical Control machines.

Text Books

1. Rao P N, "Manufacturing Technology, Vol 2, Metal Cutting and Machine Tools", 2nd Edition, Tata McGraw Hill, New Delhi, 13th reprint 2012
2. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company, 7th edition, 2014.

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References

1. Rajput R K, "A Text Book of Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, Reprint 2016
2. Sharma P C, "A Text book of Production Engineering", S Chand & Co Ltd., Reprint 2008
3. Jain R K, "Production Technology", Khanna Publishers, New Delhi, 17th edition, 2012.

Web References

- http://nptel.ac.in/courses/112105126/
- http://nptel.ac.in/courses/112105127/

BoS Chairman

Course Code: 16PET41	**Course Title:** FLUID MECHANICS AND MACHINERY (End Semester Theory Exam common to 16AUT32)	
Core/Elective: Core	**L : T : P : C**	3 :0 : 2 : 4
Type: Theory & Practical	**Total Contact Hours:**	75 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics – I
- Applied Physics

Course Objectives

The course is intended to

1. Calculate the properties of fluids.
2. Apply the principles of kinematics and dynamics for fluid flow.
3. Determine flow rates, head loss in viscous and turbulent flow.
4. Evaluate the performance of various types of turbines.
5. Evaluate the performance of various types of Pumps

UNIT I FLUID PROPERTIES AND STATICS 9

Fundamental Units and Dimensions, Properties-mass density, specific weight, specific gravity, specific volume, surface tension, capillarity and compressibility-Problems, Viscosity- Newton's law of viscosity and dynamic viscosity, kinematic viscosity - Problems, types of Fluids, concept of Continuum, Statics - Pressure, Pressure head, Pascal's law- Problems, Simple and differential manometers-Problems.

UNIT II PRINCIPLES OF KINEMATICS AND DYNAMICS IN FLUID FLOW 9

Types of Fluid flow-Steady, unsteady, uniform, non-uniform, Laminar, turbulent, rotational, ir-rotational, compressible, incompressible, 1D, 2D and 3D flows, application of control volume to continuity equation, Kinematics-Lagrangian and Eularian approach – Stream lines, path lines and streak lines, Dynamics-Euler's equation (Bernoulli's equation)-applications-Venturimeter Orifice meter and Pitot tube - Problems, Velocity and Acceleration of fluid flow, Newton's second law of motion - momentum equation for a fluid- Problems.

UNIT III FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS 9

Major Head losses in pipes - Darcy Weisbach's equation - Problems, Minor losses in Pipe bend, entry, exit, sudden enlargement, sudden contraction – Problems, Flow through Pipes - series pipe, Equivalent pipe, Parallel pipe, Dimensional Homogeneity and Buckingham's π Theorem– Problems, Dimensionless numbers, Model analysis, Similarities - Concept only.

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UNIT IV HYDRAULIC TURBINES 9

Impact of jets - Stationary vertical plates, Stationary curved plates - Concept only. Turbines - Reaction and Impulse, working principles, classification, Draft tube, heads and efficiency, specific speed, unit quantities, Velocity triangle- impulse and reaction turbines, Work done and Power delivered by the Pelton turbine – Problems - Performance of turbines.

UNIT V HYDRAULIC PUMPS 9

Centrifugal pumps - working principle and types, specific speed, unit quantities, heads and efficiency, Priming, Cavitation, Performance curves, Net Positive Suction Head, Reciprocating pump and rotary pump – working, types, Performance of positive displacement pumps

Course Outcomes

At the end of the course students will be able to:

CO1: Calculate the properties of real fluids such as water, oils and mercury
CO2: Determine the flow properties of ideal fluid by applying the kinematic and dynamic principles
CO3: Determine flow rates and head losses in real fluids under viscous and turbulent flows.
CO4: Evaluate the performance of impulse and reaction turbines under various loading and head conditions
CO5: Evaluate the performance of rotary and reciprocating pumps under various head conditions

Text Books

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, Ninth Edition, 2017.
2. YunusCengel, John Cimbalal , "Fluid Mechanics- Fundamentals and Applications", Tata McGraw-Hill Education, 2014.

Reference

1. Rajput, R.K., "A Text Book of Fluid Mechanics", Chand S and Co. New Delhi, 2015.
2. Som S. K, Biswas G " Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2011.
3. Ramamritham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", DhanpatRai& Sons, Delhi, 2015.

Web References

- http://nptel.ac.in/courses/112105171/1

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Laboratory

List of Experiments: **30 Hrs**

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter
3. Determination of friction factor of given set of pipes.
4. Draw the characteristic curves of Centrifugal pump
5. Draw the characteristic curves of Reciprocating pump.
6. Draw the characteristic curves of Impulse turbine.
7. Draw the characteristics curves of Reaction turbine.

Web References

- http://nptel.ac.in/courses/112105171/1

BoS Chairman

Course Code: 16PET42	Course Title: WELDING TECHNOLOGY	
Core/Elective: Core	L : T : P : C	2 : 0 : 2 : 3
Type: Theory & Practical	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Manufacturing process I
- Manufacturing process II

Course Objective

The course is intended to:

1. Explain the basic principles of gas and arc welding
2. Explain the fusion special welding processes.
3. Explain the Non fusion special welding processes.
4. Explain the welding metallurgy ,inspection and testing of weldments.
5. Choose a suitable design of welded joints.

UNIT I INTRODUCTION, GAS AND ARC WELDING 6

Definition of welding as per American welding society (AWS), Classifications of welding, advantages and disadvantages. Basic welding positions, types of weld and joints.Gas welding, principle and equipment, applications and selection, arc welding, principle, electrodes, energy source characteristics.

UNIT II SPECIAL WELDING PROCESSES (FUSION) 6

TIG and MIG welding processes, Carbon arc welding and Atomic Hydrogen welding, stud welding, thermit welding, Electro slag welding (ESW), Plasma Arc welding (PAW), Laser beam welding (LBW), Electron beam welding (EBW), applications and selection.

UNIT III SPECIAL WELDING PROCESSES (NON-FUSION) 6

Resistance welding, friction and ultrasonic welding, diffusion welding, explosion welding, forge welding, Friction stir welding (FSW) – applications and selection.

UNIT IV WELDING METALLURGY , INSPECTION AND TESTING OF WELDMENTS 6

Definition, heat affected zone (HAZ), temperature distribution in welding, pre and post heat treatment, weld decay, weldability of steel, Cast Iron, Aluminum alloys.

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Welding defects, remedies, Destructive test methods, Non Destructive test methods (NDT) of weldments.

UNIT V DESIGN OF WELDED JOINTS 6

Basic principles, weld symbols, welding procedure specifications (WPS), residual stresses and distortion, design of weldments, Cost estimation in welding.

Course Outcomes

At the end of the course students will be able to:

C01: Explain the basic principles of gas and arc welding.
C02: Explain the various fusion special welding processes.
C03: Explain the various Non-fusion special welding processes.
C04: Explain the welding metallurgy ,inspection and testing of weldments.
C05: Choose a suitable design of welded joints for the given condition.

Text Books

1. Little R L, "Welding and Welding Technology", Tata McGraw Hill, New Delhi, 2015.
2. Parmer R S, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2013.

References

1. Larry Jeffus, "Welding Principles and Applications", Delmar Publishers, New York, 2012.
2. Howard B Cary and Scott C Hezler "Modern Welding Technology", Pearson, New Delhi, 2005.
3. Davies A C, "Welding", Cambridge University Press, New York, 2005.
4. "AWS Welding Handbooks", AWS New York, 2011.

Web References

- http://www.nptel.ac.in/courses/113105023/

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Laboratory

List of Experiments: **30 Hrs**

Shield metal arc welding (SMAW)

1. Demonstration & Simulator practice on welding.
2. Job preparation Practice for welding.
3. Build up Practice on welding.
4. 1G Butt Joint Practice on Welding.
5. 2F-T Joint Practice on Welding.
6. Bead on Plate without (filler metal) Fusion Practice.

Tungsten Inert Gas welding (TIG)

7. Demonstration & Simulator practice on welding.
8. Job preparation Practice for welding.
9. Build up Practice on Welding welding.
10. 1G Butt Joint Practice on Welding.
11. 2F-T Joint Practice on Welding.
12. Bead on Plate without (filler metal) Fusion Practice.

BoS Chairman

Course Code:16PET43	Course Title: DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	
Core/Elective: Core	L : T : P : C	3: 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Fluid Mechanics and Machinery
- Theory of Machines - II

Course Objective

The course is intended to

1. Explain the fluid power systems.
2. Explain construction and working of hydraulic system .
3. Design hydraulic circuit to perform the desired function.
4. Explain construction and working of pneumatic system
5. Design of pneumatic circuit to perform the desired function.

UNIT I FLUID POWER SYSTEM AND FUNDAMENTALS 6

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components -Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system - Properties of hydraulic fluids - Types of fluids.

UNITII HYDRAULIC SYSTEM AND COMPONENTS 12

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Hydraulic symbols - Hydraulic circuits for linear actuators - Hydraulic circuits using different actuating devices - Speed control circuits - Sequencing circuit - Synchronizing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Milling operation, Grinding Machine - Hydraulic braking in Automobile.

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UNIT IV PNEUMATIC SYSTEM AND COMPONENTS 9

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator, air lubricator - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valve – Flow control valve - Pneumatic symbols

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Pneumatic circuits for single acting cylinder, Double acting cylinder - Pneumatic circuits using manual, mechanical, electrical actuating devices - Cascade method for sequencing: two and three Cylinders - Step counter method- Hydro-Pneumatic circuit - Material handling system circuit - Multiple operation Machining.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the fluid power systems with advantages and applications.
CO2: Explain construction and working of hydraulic system components.
CO3: Design hydraulic circuit to perform the desired function.
CO4: Explain construction and working of pneumatic system components
CO5: Design of pneumatic circuit to perform the desired function.

Text Books

1. Esposito Anthony, "Fluid Power with Applications", Pearson Education Inc., New York, 2008.
2. Majumdar, S.R., "Oil Hydraulic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006.

References

1. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.
2. Andrew Parr, "Hydraulics and Pneumatics, A technician's and engineer's guide", Third Edition, Butterworth-Heinemann, 2011.
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006

Web References

- http://www.nptel.ac.in/courses/112106175/
- http://nptel.ac.in/courses/112105046/
- http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2_Hydraulics_control_in_machine_tools.pdf
- http://maysaaiat.weebly.com/uploads/5/8/8/3/5883161/atm1122_hydraulics_module_1.pdf

BoS Chairman

Course Code: 16EEL43	Course Title: ELECTRICAL DRIVES AND CONTROLS LABORATORY (Common to Production & Mechanical)	
Core/Elective: Core	L : T : P : C	0 : 0 : 4 : 2
Type: Practical	Total Contact Hours:	60 Hours

Course Objective

The course is intended to:

1. Analyze the DC motor to verify its mechanical characteristics.
2. Demonstrate the DC motor and induction motor
3. Demonstrate the stepper motor drives
4. Demonstrate the megger, multimeter and control circuit components

List of Experiments

1. Draw the load characteristics of DC shunt motor.
2. Draw the load characteristics of DC series motor.
3. Draw the load characteristics of 3 Phase Induction Motor.
4. Draw the speed control curves of DC shunt motor.
5. Draw the speed control curves of 3 Phase Induction Motor using VFD.
6. Draw the speed control curves of DC Shunt Motor using Bridge Rectifier.
7. Draw the speed control curve of DC Shunt Motor using chopper.
8. Demonstrate the Position Control of Stepper Motor.
9. Demonstrate insulation testing of motors using Megger.
10. Demonstrate the Star-delta starter and Three-point starter.

Course Outcomes

At the end of the course students will be able to:

CO1: Analyze the DC motor to verify its mechanical characteristics.
CO2: Demonstrate the DC motor and induction motor to operate in different speeds.
CO3: Demonstrate the stepper motor drives to operate in various speeds
CO4: Demonstrate the megger, multimeter and control circuit components to measure and control various electric parameters.

BoS Chairman

Course Code: 16MEL41	**Course Title:** METAL CUTTING PROCESSES LABORATORY (Common to Production & Mechanical)	
Core/Elective: Core	**L : T : P : C**	0 : 0 : 4 : 2
Type: Practical	**Total Contact Hours:**	60 Hours

Course Objective

The course is intended to:

1. Develop process sequence for manufacturing a machined part
2. Use Lathe, Automat, Drilling, Milling, Slotting and grinding machines

List of Experiments

1. Exercise on turning of shaft.
2. Exercise on Cylindrical Grinding.
3. Exercise on Key-way Milling.
4. Exercise on Spur Gear Cutting.
5. Exercise on Surface Grinding.
6. Exercise on Machining of bolt in capstan lathe.
7. Exercise on Shaping- Male dove tail part.
8. Exercise on Drilling, Reaming and Tapping.
9. Exercise on Key-way Machining in Slotting machine.
10. Exercise on Assembly of machined components

Course Outcomes

At the end of the course the student will be able to

CO1: Develop process sequence for manufacturing the given machined part using the available machine tools.

CO2: Use Lathe, Automat, Drilling, Milling, Slotting and grinding machines to manufacture a given machined part.

BoS Chairman

Course Code: 16PSL41	Course Title: ETHICAL AND MORAL RESPONSIBILITY (Common to all B.E/B.Tech Programmes)	
Core/Elective: General	L : T : P : C	0: 0 : 2 : 1
Type: PS	Total Contact Hours:	30 Hours

Course Objective

The course is intended to:

1. Articulate the importance of ethical and moral responsibilities
2. Explain the fundamental aspects of ethics and morality
3. Validate one's appropriate and inappropriate behaviors.
4. Elaborate code of conduct
5. Explain the importance of professional practices.

UNIT I ETHICAL PRACTICES - IMPORTANCE 8

Why ethical practices; The current day scenario of ethical practices – parents, society, politics & business; Awareness of skewedness of information – news, advertisements and other media; The need for ethical and moral responsibility on a personal level; Handling oneself amidst peer pressure and societal pressure;

UNIT II ETHICAL PRACTICES - FUNDAMENTALS 6

Morality & Ethics; Moral issues, inquiry, moral dilemmas; Moral autonomy – Kohlberg's theory and Gilligan's refinement; Theories on "right action" – virtue ethics, utilitarianism, duty ethics, rights ethics – resolving moral dilemmas; justifying moral obligations;

UNIT III CODES OF CONDUCT 8

Importance of code of conduct and its role;Evolving draft Code of conduct for different roles – son/daughter, student, future employee & citizen; Reflectionon real time incidences at the college

Engineers as responsible experimenters; Faith of the Engineer (ABET); Pledge and Code of ethics as per National Society of Professional Engineers (NSPE); Code of Ethics of Institution of Engineers (India); Case studies and discussions in professional context

UNIT IV PROFESSIONAL PRACTICES AT WORK 8

Transition from a student to a professional; Importance of professional practices at work; Integrity as the topmost virtue of a professional; Self-awareness: Where competence ends and professionalism takes over; Professional qualities;

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Need to align oneself to culture & values of organizations; Need to embrace diversity in organizations.

At least one lecture by senior people from Industries/Government organizations / reputed institutions to be conducted.

Course Outcomes

At the end of the course the student will be able to:

CO1 Articulate the importance of ethical and moral responsibilities

CO2 Explain the fundamental aspects of ethical practices

CO3 Validate one's appropriate and inappropriate behaviors in various roles

CO4 Elaborate code of conduct of professional bodies

CO5 Explain the importance of professional practices as a future employee/entrepreneur

Course handouts (compiled by Professional Skills team, MCET)

1. Learner's workbook (for the student)
2. Learner's logbook (Journal)
3. Reading Material

References

1. Mike W Martin & Roland Schinzenger, Ethics in Engineering, Tata McGraw-Hill Education Pvt. Ltd, Third Edition.
2. Code of conduct document, MCET student handbook
3. Gail D Baura, "Engineering Ethics - an industrial perspective", Academic Press, Elsevier, 2006.
4. Subrato Bagchi, The professional - Defining the new standard of Excellence at work, Penguin India, 2011.

END OF SEMESTER- IV

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Semester V

Course Code: 16MET51	Course Title: DESIGN OF MACHINE ELEMENTS (Common to Automobile, Production & Mechanical)	
Core/Elective: Core	L : T : P : C	3 : 2 : 0 : 4
Type: Theory	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Theory of Machines-II
- Strength of Materials

Course Objective

The course is intended to

1. Design the machine elements subjected to static loads.
2. Design the machine elements against fluctuating and impact loads
3. Calculate the design parameters for power transmitting element .
4. Determine the design parameters of helical and leaf spring.
5. Design/Select a suitable bearing.

UNIT I DESIGN FOR STATIC LOAD OR STEADY STRESSES 12

Design Processes and its types. Static stress- yield stress and ultimate stress, direct, bending bearing and shear stresses - factor of safety, selection. Selection of materials and its properties - eccentric loading-stress due to eccentric loading, problems. Theories of failure, simple problems.

UNIT II DESIGN FOR FLUCTUATING AND IMPACT LOADS 12

Fatigue, types, Endurance limit, modifying factors, relation between endurance limit, ultimate tensile strength and yield strength, problems on different fatigue loading conditions. Stress concentration, stress concentration factor, causes of stress concentration, method of reducing stress concentration, stress concentration factor for different material configuration. Notch sensitivity, factors affecting of notch sensitivity.Impact loading, shock loading, simple problems.

UNIT III DESIGN OF SHAFTS, KEYS, AND COUPLINGS 12

Difference between shaft, axle and spindle, Shaft materials, criteria of shaft design, different transmitting elements on a shaft, shaft design against static loading for given application. Shaft design for fatigue loading. Keys, types of keys, stresses developed in the key. Spline, stresses in spline shaft, design of shunk key and spline. Couplings,

BoS Chairman

types of coupling, design of coupling based on given speed and load conditions, Design of flexible coupling based on given speed and load conditions.

UNIT IV DESIGN OF SPRINGS 12

Springs, types of springs, applications, spring terminology. Stresses in helical springs, Design of helical and concentric spring for given loading. Leaf springs, NIP in leaf springs Design of leaf spring for given application.

UNIT V DESIGN OF BEARING 12

Bearings, bearing types, Parts of the bearing, rolling contact bearing, its applications. Load carrying capacity, equivalent load, Life of bearing, Load life relationship, Problems. Selection of ball bearings from manufacturing catalogue. Sliding contact bearings, types and Nomenclature. Hydrodynamic bearing, load carrying capacity, lubrication, selection of lubricant, equivalent load, minimum oil film thickness- length to diameter ratio- bearing pressure, radial clearance. Mckees equation, Somer field equations -Bearing characteristic number problems.

NOTE: (Use of approved Design Data Book is permitted in the End semester examination)

Course Outcomes

At the end of the course students will be able to:

CO1: Design the machine elements subjected to simple and combined static loads.
CO2: Design the machine elements against fluctuating loads and impact loads
CO3: Calculate the design parameters for power transmitting element such as shaft, key, and coupling.
CO4: Determine the design parameters of helical and leaf spring for given application.
CO5: Design/Select a suitable bearing for the given application.

Text Books

1. V.B. Bhandari. "Design of Machine Elements" Tata McGraw Hills Education, 3rd edition2014.
2. P. C Sharma and A. K Agarwal. "Machine Design" (SI units). S.K. Kataria& Sons. Reprint 2013.

References

1. Shigley J.E and Mischke C.R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw Hill, 2012.
2. Ugural A.C, "Mechanical Design – An Integral Approach", McGraw-Hill Book Co., 2010.

BoS Chairman

3. Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education, 2012.

Web References

- http://nptel.ac.in/courses/112105124/
- http://www.nptel.ac.in/downloads/112105125/
- http://nptel.ac.in/courses/112106137/
- http://www.skf.com/in/index.html

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Course Code: 16PET51	Course Title: METAL FORMING TECHNOLOGY	
Core/Elective: Core	L : T : P : C	3 :0: 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Metal Cutting Processes
- Material Science

Course Objectives

The course is intended to:

1. Describe the procedure of Metal forming process and its sequences required for manufacture component.
2. Select appropriate forging and rolling processes to manufacture component.
3. Select appropriate extrusion and drawing processes to manufacture Component.
4. Explain operational and procedural steps required in sheet metal process.
5. Select appropriate processes and its sequences required for manufacture of a given recent advances.

UNIT I METAL FORMING 9

Hot working and Cold working of metals. Rolling: Rolling mills, Roll passes and sequences, Rolling defects; Forging: Types (Smith, Drop, Press & Machine), Forging operations (Drawing down / Swaging, Upsetting, Punching, Bending, Coining); Forging defects; Extrusion: Types (Direct, Indirect, Impact, Tube). Drawing: Tube drawing, Wire drawing.

UNIT II FORGING AND ROLLING 9

Principle – classification – equipment – tooling – processes parameters and calculation of forces during forging and rolling processes – Ring compression test - Post forming heat treatment – defects (causes and remedies) – applications – Roll forming.

UNIT III EXTRUSION AND DRAWING PROCESSES 9

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod/Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes –Mannesmann process of seamless pipe manufacturing – Tube bending.

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UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics, Shearing processes (Punching, Piercing, Perforation, Blanking, Trimming, Notching, Nibbling and Shaving processes) Progressive, Compound and Combination dies. Bending - Spring back, allowance, operations (Angle bending, Roll bending, Roll forming, Seaming). Drawing processes (Shallow drawing, Deep drawing, Reverse drawing and redrawing), Rigid die forming processes (Embossing, Coining and Stamping), Stretch forming, Defects in sheet metal operations.

UNIT V RECENT ADVANCES 9

Super plastic forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming - P/M forging – Isothermal forging – high speed hot forging – near net shape forming high velocity extrusion – CAD and CAM in forming

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the procedure of Metal forming process and its sequences required for manufacture component.

CO2: Select appropriate forging and rolling processes to manufacture component.

CO3: Select appropriate extrusion and drawing processes to manufacture component

CO4: Explain operational and procedural steps required in sheet metal process.

CO5: Select appropriate processes and its sequences required for manufacture of a given recent advances.

Text Books

1. Dieter G.E., "Mechanical Metallurgy", McGraw Hill, Co., S.I. Edition, 2001
2. Nagpal G.R. "Metal forming processes", Khanna publishers, New Delhi, 2004
3. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials" —Pearson Education, 4th Edition, 2009.
4. Rao P.N. "Manufacturing Technology — Vol.1", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013

References

1. HMT Bangalore, "Production Technology', Tata McGraw Hill =n Company Limited, New Delhi, 2008.
2. K. Hajra Choudhury,Nirjhar Roy,S. K. Hajra Choudhury, "Elements of Production Technology —Vol.II", Asia Publishing House, 2008..
3. Jain. R.K., "Production Technology", Khanna Publishers, New Delhi, 2012.
4. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials", 4thEdition, Pearson Education, 2003.

BoS Chairman

5. Edward M.Mielink, "Metal working science Engineering, McGraw Hill, Inc, 2000.

Web References

- http://nptel.ac.in/courses/112107144/
- http://nptel.ac.in/courses/112107145/

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Course Code: 16PET52	Course Title: ENGINEERING STATISTICS AND QUALITY CONTROL	
Core/Elective: Core	L: T : P : C	3: 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Engineering Mathematics I
- Engineering Mathematics II

Course Objectives

The course is intended to:

1. To provide an introduction to fundamental concepts of statistical Process control
2. Enhance the student understanding of the complexities of Statistical Analysis and control chart interpretation
3. To understand the concept of reliability and it's improving techniques and design of experiments.

UNIT I SAMPLING THEORY AND TESTING OF HYPOTHESIS 9

Population, sample – influence of sample size – Estimation of population parameter from sample – mean and variance, difference of means, variances and ratios of variances – Tests of hypothesis –large and small samples – Chi-square distribution – F distribution.

UNIT II STATISTICAL PROCESS CONTROL 9

Variation in process – Factors – control charts – variables X R and X, Attributes P, C and U-Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts Design of single sampling plan – standard sampling plans for AQL end LTPD – use of standard sampling plans –Sequential sampling plan.

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UNIT IV RELIABILITY AND QUALITY 9

Life testing – failure characteristics – meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques -Pareto analysis.

UNIT V EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method –Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain sampling theory and testing of hypothesis.
CO2: Explain various statistical process control charts.
CO3: Select appropriate acceptance sampling.
CO4: Select appropriate reliability and quality methods.
CO5: Design Experimental design and Taguchi Method.

Text Books

1. Amcta Mitra "Fundamentals of Quality Control and improvement" Pearson Education, 2002.

References

1. Bester field D.H., "Quality Control" Prentice Hall, 7th edition 2003
2. Manohar Mahajan, "Statistical Quality Control", Dhanpal Rai & Sons, 2001.
3. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publications, 2004.

Web references

- https://nptel.ac.in/courses/112107238/49.
- https://nptel.ac.in/courses/112107143/3.

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Course Code: 16PET53	**Course Title:** COMPUTER INTEGRATED MANUFACTURING (End Semester Theory Exam Equivalent to16MEE28)	
Core/Elective: Core	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Write NC, DNC and CNC program in CIM.
2. Design manufacturing solution based on CAD System in CIM.
3. Select Materials handling and Storage in CIM.
4. Write coding for Group Technology in CIM
5. Design automated manufacturing based on Artificial Intelligent system, Expert system and FMS in CIM.

UNIT I INTRODUCTION TO CIM 9

Automated Manufacturing system – Needs, Types.CIM - CIM wheel - Components, Evolution, needs, Benefits. NC system - Components, NC motion control system, application, advantages and disadvantages. Computer Numerical control System – Components, functions, advantages. Direct Numerical Control System – Components, functions, advantages.

UNIT II COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate. - typical CAD command structure - Types CAD modeling - wire frame modeling, surface modeling and solid modeling.

UNIT III MATERIAL HANDLING AND STORAGE SYSTEMS 9

Materials handling and Storage Systems - Automated storage and retrieval systems, carousel storage systems - Interfacing of Handling and Storage with Manufacturing system. AGVs - types, advantages and application. Robot – Basic concepts, applications.

UNIT IV GROUP TECHNOLOGY 9

Group Technology – Role of G.T in CAD/CAM Integration, part families, part Classification and coding–DCLASS and MICLASS and OPITZ coding systems - facility design using G.T, benefits of G.T -Cellular Manufacturing.

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UNIT V ARTIFICIAL INTELLIGENT SYSTEM, EXPERT SYSTEM AND FMS 9

Artificial Intelligence System, Basic concepts of Artificial intelligence, Intelligent systems and expert systems. Flexible manufacturing systems – Configurations, workstations, planning, applications and benefits – Automated inspection and testing - Machine vision.

Course Outcomes

At the end of the course students will be able to:

CO1: Write program for NC, DNC and CNC in Automated Manufacturing systems such as CIM.

CO2: Design manufacturing solution with the features of CAD System such as Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate in design and modeling for CIM

CO3: Select appropriate Materials handling and storage systems such as AGVs, AS/RS and Robots for material handling and Storage System in CIM

CO4: Write codes using DCLASS, MICLASS and OPITZ for Group Technology in CIM

CO5: Design Automated Manufacturing based on Artificial Intelligent system, Expert system and FMS to gradually convert Traditional Manufacturing environment in CIM.

Text Books

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2015.
2. Mikell. P. Groover and Emory ZimmersJr.,"CAD/CAM", Prentice hall of India Pvt. Ltd., 2013.

References

1. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. Ltd., 2005

Web References

- https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
- https://en.wikipedia.org/wiki/Computer-aided_manufacturing
- https://en.wikipedia.org/wiki/Integrated_Computer-Aided_Manufacturing

BoS Chairman

Course Code: 16PET54	Course Title: CNC MACHINES AND CONTROL SYSTEMS	
Core/Elective: Core	L: T : P : C	3: 0 :0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Understand evolution and principle of CNC machine tools.
2. Describe constructional features of CNC machine tools.
3. Explain drives and positional transducers used in CNC machine tools.
4. Write simple programs for CNC turning and machining centres.
5. Generate CNC programs for popular CNC controllers.

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 7

Evolution of CNC Technology, principles, features, advantages, applications,CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection

UNIT II STRUCTURE OF CNC MACHINE TOOL 10

CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT III DRIVES AND CONTROLS 9

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

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UNIT IV CNC PROGRAMMING 10

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification- P-M-K- N-S-H, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain evolution and principle of CNC machine tools
CO2: Describe constructional features of CNC machine tools
CO3: Explain drives and positional transducers used in CNC machine tools
CO4: Write simple programs for CNC turning and machining centres
CO5: Generate CNC programs for popular CNC controllers

Text Books

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi,2005.
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.

References

1. "James Madison, "CNC Machining Hand Book", Industrial Press Inc., 1996.
2. Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition, Industrial Press Inc, New York, 2002
3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
5. Radhakrishnan P, "Computer Numerical Control Machines", New Central Book Agency, 2002.
6. Rao P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.

Web References

- https://nptel.ac.in/courses/112105211/
- https://nptel.ac.in/courses/108105063/24

BoS Chairman

Course Code: 16MEL52	Course Title: COMPUTER AIDED MACHINE DRAWING LABORATORY (Common to Automobile ,Production and Mechanical)	
Core/Elective: Core	L : T : P : C	0: 0 : 4 : 2
Type: Practical	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics
- Metrology & Measurements
- Computer Aided Drafting and Modeling Laboratory

Course Objective

The course is intended to

1. Develop part models.
2. Prepare assembly drawings.

List of Experiments

1. Exercise on Knuckle joint
2. Exercise on Flange coupling
3. Exercise on Plummer Block
4. Exercise on Screw Jack
5. Exercise on Piston and Connecting rod
6. Preparation of Knuckle joint assembly drawing
7. Preparation of Flange coupling assembly drawing
8. Preparation of Plummer block assembly drawing
9. Preparation of Screw Jack assembly drawing
10. Preparation of Piston and Connecting rod assembly drawing

Course Outcomes

At the end of the course the student will be able to

CO1: Develop part models of machine components as per the design specification to prepare the assembly.

CO2: Prepare assembly drawings of machine components to disseminate how the parts fit together.

References

1. Gopalakrishna, K. R., "Machine Drawing", SubhasPublishing House, 20th Edition, 2007.
2. Cecil Jensen, Jay D. Helsel, Dennis R. Short , "Engineering Drawing & Design", McGraw-Hill Higher Education, 7th edition, 2007.

BoS Chairman

Course Code: 16PEL51	Course Title: FLUID POWER LABORATORY	
Core/Elective: Core	L : T : P : C	0: 0 : 4 : 2
Type: Practical	Total Contact Hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Fluid Mechanics and Machinery
- Hydraulics and Pneumatics

Course Objective

The course is intended to

- Design circuit for industrial application, automation and domestic needs with the help of hydraulic and pneumatic system.

List of Experiments

1. Design a hydraulic circuit for the actuation of hydraulic cylinder using Mechanical actuation.
   a) Using 4/2 DCV.
   b) Using 4/3 DCV.
2. Design a hydraulic circuit for the actuation of hydraulic cylinder using Electrical actuation.
   a) Using 4/2 DCV.
   b) Using 4/3 DCV.
3. Design a hydraulic circuit for Speed regulation of a double-acting cylinder (Meter in & Meter out).
4. Design a hydraulic circuit for Clamping and Drilling function (Pressure reducing valve).
5. Design a Pneumatic circuit for the actuation of single and double acting cylinder using Mechanical actuation.
6. Design a Pneumatic circuit for the actuation of single and double acting cylinder using Electrical actuation.
7. Develop a CASCADE circuit for given sequence operation (two and three cylinders).
8. Develop a Pneumatic circuit for Material handling application.

Course Outcomes

At the end of the course students will be able to:

CO1: Develop a hydraulic circuit for milling, grinding and automobile braking application.

CO2: Develop a pneumatic circuit for material handling and machining application.

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Course Code: 16PSL51	**Course Title:** TEAMNESS AND INTER-PERSONAL SKILLS(TIPS) (Common to All BE/B.Tech Programmes)	
Core/Elective: Core	**L : T : P : C**	0 : 0 : 2 : 1
Type: PS	**Total Contact Hours:**	30 Hours

Course Objective

The course is intended to

1. Be aware of attitudinal, behavioral and emotional aspects of self
2. Learn continuously and be in harmony with self
3. Understand others' preferences, values, roles & contexts
4. Identify barriers to harmonious relationships
5. Work collaboratively as a team

UNIT I HARMONY WITH SELF

Importance of learning about self continuously; Approaches to learn about self: introspection, being open to feedback, critical incidences as opportunities; Understanding life stages and challenges associated with them; Healthy ways of handling self in response to life's challenges;
Instruments/inventories to understand self and others: A) Know your temperament, B) Mayer Briggs Type Indicator, C) Interpersonal Needs Inventory (tentative).

UNIT II HARMONY WITH OTHERS

Importance of living in harmony with others; What it takes to live in harmony with others; Understanding preferences, values, roles and contexts of others; Approaches to navigating through differences between self and others;
Barriers to harmonious relationships - Perceptions, Judgments, and Emotional instability; Ways to handle each of the barriers; Importance of reaching-out to others

UNIT III GROUP DYNAMICS AND CONFLICTS RESOLUTION

Group dynamics: overt and covert processes at micro and macro levels; Understanding the basis of conflicts; Understanding one's own conflict handling style; Methods to handling conflicts effectively.

UNIT IV WORKING IN TEAMS

Effectiveness in communication; Forming – storming – norming and performing model; Competition vs collaboration – impact of both on team tasks; TEAM Questionnaire – components of a healthy team and approaches to improving them.

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Course Outcomes

At the end of the course, students will

CO1: Be aware of attitudinal, behavioral and emotional aspects of self
CO2: Prefer to learn continuously about self and be in harmony with self
CO3: Understand others' preferences, values, roles & contexts and be in harmony with others
CO4: Identify barriers to harmonious relationships and derive ways to handle them
CO5: Work collaboratively as a team to deliver expected outcomes

Mode of delivery:

1. A 2-day learning workshop
1. Activities (experiential learning)
2. Audio visuals (affective learning)
3. Case discussions (cognitive learning)
4. Instruments/questionnaires (reflective learning) Guided by Learner's workbook.

2. Continuous learning guided by learning journal, and reviews by faculty
3. Half-day reinforcement session towards the end of the semester

Assessments and Evaluation:

Assessment	Details	Weightage	Administration	By Whom	When
Continuous Assessment					
Initial Knowledge Test	Multiple choice questions (20)	10%	Pen and paper	Internal team	Immediately after the initial workshop.
Review of student journal	Student held journal book.	50%	Student journals to be reviewed	Trained Internal faculty	Once in a week.
Semester End Examination:					
Final comprehensive Knowledge test	Multiple choice questions (40)	10%	Pen and paper	Internal team	End of semester after the reinforcement program.
Viva-Voce	Scenario based questions	30%		Internal team	

Continuous Assessment = 60%
Semester end examination = 40%
An overall mark of 50 is to be scored for a pass in the course

END OF SEMESTER V

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BoS Chairman

SEMESTER VI

Course Code: 16PET61	**Course Title: FINITE ELEMENT ANALYSIS IN MANUFACTURING** (For Production Engineering Programme)	
Core/Elective: Core	**L: T : P : C**	3: 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Numerical methods
- Metal forming, joining, casting process

Course Objectives

The course is intended to:

1. Convert physical problem into mathematical model
2. Solve one dimensional structural problem
3. Solve 2D vector variable problem
4. Solve 1D and 2D scalar variable problem.
5. Determine the shape function, Jacobean matrix, element, stiffness matrix For 2d quadrilateral problem

UNIT I INTRODUCTION 9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems - Mathematical representation of manufacturing processes - metal casting, metal cutting, metal forming, welding, heat treatment and injection molding, use of partial differential equations, interpretation of boundary conditions and initial conditions.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types - Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems Review of theory of plasticity applied to metal forming processes, flow curve, models for friction and heat transfer

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UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements. Mathematical modelling of solidification processing, boundary conditions, initial conditions solutions by FEA - simple case studies on sand mold and die casting.

UNIT V ISOPARAMETRIC FORMULATION 9

Mathematical modelling of solidification processing, boundary conditions, initial conditions solutions by FEA - simple case studies on sand mold and die casting, Introduction to Computer aided design and analysis of Injection molded components using CAE softwares- Natural co-ordinate systems – Isoparametric elements– Shape functions for iso parametric elements – One and two dimension

Course Outcomes

At the end of the course students will be able to:

CO1: Convert physical problems into mathematical model using finite element procedure
CO2: Solve the one dimensional structural problems.
CO3: Solve the vector variable problems using 2D CST element
CO4: Solve the scalar variable problems using 1D and 2D elements.
CO5: Solve the vector variable problems using 2D Quadrilateral element

Text Books

1. Sindo Kou, "Transport Phenomena and Materials Processing", John Wiley & Sons Inc., New York, 2009.
2. Shiro Kobayashi, Soo Ikoh and Taylan Altan, "Metal Forming and the Finite Element Method" , Oxford and IBH Publishing,New Delhi, 2012.
3. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw- Hill, 2005

References

1. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth.
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
3. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 2009

Web references

1. https://nptel.ac.in/courses/12104115/4
2. http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf
3. https://nptel.ac.in/courses/12104116

BoS Chairman

Course Code: 16PET62	**Course Title: JIGS, FIXTURES AND DIE DESIGN** (For Production Engineering Programmes)	
Core/Elective: Core	**L: T : P : C**	3: 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming Processes
- Design of Machine Elements

Course Objectives

The course is intended to:

1. Understand the concepts of various types of jigs, fixtures and dies.
2. Design and draw jig / fixture/ die for a given component.

UNIT I LOCATION AND CLAMPING DEVICES IN JIGS AND FIXUTRES 9

Principles of Jigs and Fixture – Design concepts – Different types of locating devices – different types of clamps – Drill bushes – types – Elements of fixtures.

UNIT II DESIGN OF ELEMENTS OF JIGS AND FIXTURE 9

Design concepts of Template Jig, Plate Jig, Sandwich Jig, Vice Jaw Jig, Latch Jig, Turnover jig, Box jig – Fixtures for Milling, Grinding, Turning, Welding, and Assembly – Modular fixtures.

UNIT III PRESS WORKING OPERATION AND FORMING DIES 9

Blanking, Piercing, lancing, notching, bending design features of dies for drawing, extrusion, wire drawing and forging.

UNIT IV ELEMENTS OF DIE 9

Design concepts of the following elements of progressive, compound and Combination dies – Die block – Die shoe – punch – punch plate – punch holder – guide pins and guide bushes–strippers – knockouts – pilots – selection of standard die sets – strip layout and development.

UNIT V DESIGN AND DRAWING DIES, JIGS AND FIXTURES 9

Progressive die – compound die – Bending and drawing dies – Drill Jigs – Milling fixtures, turning fixtures.

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Course Outcomes

At the end of the course students will be able to:

CO1: Understand the fundamentals of work holding devices, locators and clamps.
CO2: Explain about elements of Jigs and Fixtures
CO3: Explain about various press working operations
CO4: Discuss about the various elements of die
CO5: Design the die for jigs, fixtures, press working operations

Text Books

1. Donaldson, B.H. Lecain, Goold V.V., Tool Design, TMH Edition, 2012.
2. Kempster M.H.A., Introduction to Jigs and Fixtures, ELBS Edition, 2009

References

1. Paquin, Die Design Fundamentals, Industrial Press Inc, New York, 2005
2. Fundamentals of Tool design, Society Of Manufacturing Engineers, 2010.
3. P.H.Joshi., Jigs and Fixtures, Mcgraw Hill Education, 2010

Web references

- https://nptel.ac.in/courses/112105127/pdf/LM-33.pdf
- https://nptel.ac.in/courses/112105126/34

BoS Chairman

Course Code: 16PET63	Course Title: TOTAL QUALITY MANAGEMENT	
Core/Elective: Core	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Manufacturing Processes I
- Manufacturing Processes II

Course Objectives

The course is intended to:

1. Explain the views of different quality gurus
2. Explain the principles and concepts inherent in a Total Quality Management (TQM) approach
3. Evaluate an industrial process
4. Explain the various quality tools for identifying appropriate process improvements
5. Explain the quality management

UNIT I INTRODUCTION 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

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UNIT IV TQM TOOLS 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, overview of FMEA – Stages of FMEA

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2004 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits .

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the views of different quality gurus towards Total Quality Management.

CO2: Explain the principles and concepts inherent in a Total Quality Management (TQM) approach for managing a manufacturing or service organization

CO3: Evaluate an industrial process using control charts, process capability indices and six sigma.

CO4: Explain the various quality tools for identifying appropriate process improvements such as Bench marking, QFD,TPM and FMEA.

CO5: Explain the quality management with respect to the ISO 9000 & ISO 14000 quality management standards.

Text Books

1. Dale H. Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2011(Indian reprint 2004).
2. Subbarajramasamy, " Total Quality Management" McGraw-Hill, 2008.

References

1. James R.Evans& William M. Lidsay, "The Management and Control of Quality", 5th Ed., South-Western (Thomson Learning), 2002
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 2014.

Web References

- https://en.wikipedia.org/wiki/Total_quality_management

BoS Chairman

Course Code: 16PET64	Course Title: UNCONVENTIONAL MACHINING PROCESSES (End Semester Theory Exam Equivalent to 16MEE19)	
Core/Elective: Core	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objective

The course is intended to:

1. Explain the Classification of UCM
2. Describe the mechanical energy based UCM
3. Explain electrical energy based unconventional machining processes
4. Explain Chemical & Electro chemical energy based UCM
5. Describe Thermal energy based unconventional UCM

UNIT I INTRODUCTION 9

Need for unconventional machining process-Advantages of UCM - Disadvantages of UCM - Comparison of conventional and unconventional machining processes - Process parameters - Processes based on type of energy required to shape the material- Processes based on mechanism of material removal- Processes based on transfer media- Processes based on source of energy

UNIT II MECHANICAL ENERGY BASED UCM PROCESSES 9

Principle of Mechanical energy based UCM Processes - Mechanical energy based unconventional machining processes: Ultrasonic machining process, Abrasive Jet machining process, Water Jet Machining process - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Mechanical energy based unconventional machining processes

UNIT III ELECTRICAL ENERGY BASED UCM PROCESSES 9

Principle of Electrical energy based UCM Processes - Electrical energy based unconventional machining processes: Electric Discharge machining - Principle, Layout of EDM process, Functions and types of dielectric fluid, Properties of different tool materials, Working of R-C (Relaxation) circuit, R-C-L circuit, rotary pulse generator circuit, controlled pulse generator circuit, Process parameters in EDM Process, Mechanism of metal removal, Applications, Advantages and Disadvantages. Wire cut EDM (WCEDM) process: Layout, Construction and working of various elements,

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Applications, Advantages and Disadvantages.Drilling and Die sinking by EDM process. Comparison of Electrical energy based unconventional machining processes

UNIT IV CHEMICAL & ELECTRO CHEMICAL ENERGY BASED UCM PROCESSES 9

Principle of Chemical & Electro chemical energy based UCM Processes - Chemical & Electro chemical energy based unconventional machining processes: Chemical machining, Electro chemical machining, Electro chemical grinding, Electro chemical honing processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Chemical & Electro chemical energy based unconventional machining processes

UNIT V THERMAL ENERGY BASED UCM PROCESSES 9

Principle of Thermal energy based UCM Processes - Thermal energy based unconventional machining processes: Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Thermal energy based unconventional machining processes.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the various methods of Unconventional Machining Processes based on type of energy required, mechanism of material removal, transfer media and source of energy.

CO2: Select mechanical energy based unconventional machining processes such as Ultrasonic machining process, Abrasive Jet machining process and water jet machining process based on machining requirements for a product.

CO3: Choose Electrical energy based unconventional machining processes such as EDM based on machining requirements for a product.

CO4: Select Chemical & Electro chemical energy based unconventional machining processes such as Chemical machining, Electro chemical machining and Electro chemical grinding based on machining requirements for a product..

CO5: Choose Thermal energy based unconventional machining processes such as Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes for special applications.

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Text Books

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

References

1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.
2. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008.

Web References

- https://en.wikipedia.org/wiki/Machining
- https://en.wikipedia.org/wiki/Laser_beam_machining
- https://en.wikipedia.org/wiki/Electrical_discharge_machining
- http://mechteacher.com/manufacturing-technology/
- http://www.engineershandbook.com/MfgMethods/nontraditionalmachining

BoS Chairman

Course Code: 16PET65	**Course Title:** PRODUCTION PLANNING AND CONTROL	
Core/Elective: Core	**L: T : P : C**	3: 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production job-batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis-Economics of a new design.

UNIT II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development -Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data -Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

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UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS Fundamentals of MRP II and ERP.

Course Outcomes

At the end of the course students will be able to

CO1: Understand various components and functions of production planning and control.

CO2: Explain the workstudy in production planning and control.

CO3: Describe the product planning and process planning.

CO4: Design the production scheduling for production planning and control.

CO5: Explain inventory control and recent trends in production planning and control.

Text Books

1. Martand Telsang, "Industrial Engineering and Production Management", First Edition,S. Chand and Company, 2000.

2. James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International Edition1992.

References

1.Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984

2.Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / b Operations Management", 8th Ed.John Wiley and Sons, 2000.

3.Kanishka Bedi, " Production and Operations management", 2nd Edition, Oxford university press,2007.

4.Melynk, Denzler, " Operations Management – A value driven approach" Irwin Mcgrawhill.

BoS Chairman

5.Norman Gaither, G. Frazier, " Operations Management" Thomson learning 9th edition IE, 2007
6.K.C.Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
7. S.N.Chary, "Theory and Problems in Production & Operations Management", Tata McGraw Hill,1995.

Web references

- **https://nptel.ac.in/courses/112107238/26.**
- **https://nptel.ac.in/courses/110105067/41.**

BoS Chairman

Course Code: 16MEL61	**Course Title:** SIMULATION AND ANALYSIS LABORATORY (Common to Automobile Production and Mechanical)	
Core/Elective: Core	**L : T : P : C**	0 : 0 : 4 : 2
Type: Practical	**Total Contact Hours:**	60 Hours

Prerequisites

The student should have undergone the course(s):

- Numerical Methods
- Thermal Engineering
- Strength of Materials
- Theory of Machines -I&II
- Design of Hydraulics & Pneumatics System

Course Objective

The course is intended to

- Apply finite element simulation software
- Write programs in a mathematical simulation software

Simulation Lab

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of free vibration characteristics of spring, mass and damper system.
3. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
4. Simulation of cam and follower mechanism using C / MAT Lab.

Analysis (Simple Treatment Only)

1. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
2. Stress analysis of a plate with a circular hole.
3. Stress analysis of rectangular L bracket
4. Stress analysis of an Axi-symmetric component
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams(Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

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Course Outcomes

At the end of the course students will be able to:

CO: 1 Apply finite element simulation software to solve simple problems such as structural, thermal and vibration problems in Mechanical Engineering.

CO: 2 Write programs in mathematical simulation software to solve mathematical model of mechanical engineering applications

BoS Chairman

Course Code: 16PEL61	Course Title: CNC MACHINE LABORATORY	
Core/Elective: Core	L: T : P : C	0: 0 :4 : 2
Type: Practical	Total Contact Hours:	60 Hours

Prerequisites

- The student should have undergone manufacturing technology process.

Course Objectives

The course is intended to:

1. Study of different control systems and NC codes
2. Write programs for CNC turning centres
3. Write programs for CNC machining centres
4. Simulate tool path simulation for different components.

LIST OF EXPERIMENTS

1. Study of different control systems and NC codes.
2. Program for Turning, Facing operation.
3. Program for circular interpolation, Taper turning operation
4. Program for thread cutting operation.
5. Program for profile milling operation, circular interpolation
6. Program for Circular, rectangular pocket milling
7. Program for drilling cycle
8. NC code generation using CAD software packages

Course Outcomes

At the end of the course students will be able to:

CO1: Explain different control systems and NC codes.

CO2: Write programs for CNC turning centres.

CO3: Write programs for CNC machining centres.

CO4: Simulate tool path simulation for different components.

CO5: Apply the programming to machine industrial components.

BoS Chairman

Course Code: 16MEE18	Course Title: PROCESS PLANNING AND COST ESTIMATION (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Explain the basic concepts of process planning.
2. Apply manual and computer aided process planning
3. Explain both direct and indirect costs.
4. Analyze various cost calculation methods
5. Explain the Break Even Analysis & Cost Management

UNIT I PROCESS PLANNING, DESIGN AND CONCEPTS OF PROCESS PLAN **9**

Introduction- Place of process planning-economics- Process & Production Planning, Process Planning & Concurrent Engineering-Types of production- standardization-Production design & selection. Selection of processes, tools, cutting parameters & machine tools- Jigs and Fixtures - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs-Process capability, Process Charts.

UNIT II MANUAL AND COMPUTER AIDED PROCESS PLANNING & ESTIMATION **9**

Retrieval type/variant approach, group technology – generative approach, logics decision tress and tables, axiomatic approach – AI expert systems – feature recognition – applications Concepts, differences. Concepts, differences, different costing methods – classification of costs – cost grid-problems.

UNIT III DIRECT AND INDIRECT COST COMPONENTS **8**

Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation –

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material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – Direct Labour, Direct Material Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems.

UNIT IV COST CALCULATIONS **10**

Machined components–welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection.

OPTIMUM MACHINING CONDITIONS: Taylor's equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis.

UNIT V BREAK EVEN ANALYSIS & COST MANAGEMENT **9**

Concept, make or buy decision, assumptions, merits and demerits of break even analysis, applications. Linear, multi product break-even analysis Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications.

Course Outcomes

At the end of the course students will be able to:

CO1: Understand the basic concepts of process planning.
CO2: Evaluate the various approaches of manual and computer aided process planning and costing.
CO3: Understand the different components involved in direct and indirect costs.
CO4: Analyze the cost calculation methods of different manufacturing process.
CO5: Understand the concept of Break Even Analysis & Cost Management.

Text Books

1. Kannappan D, "Mechanical Estimating and Costing", Tata McGraw Hill, New Delhi, 2003.
2. Banga T R and Sharma S C, "Mechanical Estimating and Costing", Khanna Publishers, New Delhi, 2010.

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References

1. Russell R.S and Tailor B.W, "Operations Management", PHI, 4th Edition, 2003.
2. Chitale A.V and Gupta R.C, "Product Design and Manufacturing", PHI, 2nd Edition, 2002.
3. Kesavan R "Process Planning and Cost Estimation", New Age International Pvt. Ltd., Chennai, 2005.

Web References

- https://en.wikipedia.org/wiki/Planning
- http://nptel.ac.in/courses/Webcourse-contents/IIT Delhi/Computer%20Aided%20Design%20&%20ManufacturingII/Module%20G/Module%20G(5)/p3.htm
- https://en.wikipedia.org/wiki/Cost_estimate

BoS Chairman

Course Code: 16PEE01	Course Title: SURFACE ENGINEERING AND ANALYTICAL TECHNIQUES	
Core/Elective: Elective	L: T : P : C	3: 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

- Non Destructive Testing
- Manufacturing Process

Course Objectives

The course is intended to:

1. Understand the surface preparation techniques
2. Evaluate knowledge on thermal spraying process and electrodeposited coating.
3. Define the process of Hot dip and diffusion coating.
4. Describe the testing procedure for surface coating

UNIT I FRICTION 9

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING 9

Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non ferrous metals and alloys – selection processes – alkaline cleaning – emulsion cleaning – ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning – polishing and bulling shot peening – classification of surface engineering

UNIT III SURFACE TREATMENTS 9

Introduction – Surface properties, Superficial layer –ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings

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UNIT IV SURFACE COATINGS AND SURFACE HARDENING 9

Structure of coatings, classification of coatings, need for technical and technological coatings, techniques for producing surface layers, thermal spraying, electron beam technology, and laser based technology, ion implantation techniques, CVD methods and PVD techniques. Surface hardening by flame and induction, laser and electron beam hardening, selection and applications, surface diffusion process, carbonitriding, aluminizing, siliconizing, chromizing, sursulf, selection of diffusion process.

UNIT V ENGINEERING MATERIALS 9

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

Course Outcomes

At the end of the course students will be able to:

CO1: Understand the importance, need of surface engineering and review past, present and future status of surface engineering.
CO2: Analyze the factors responsible for damage of the surfaces by corrosion, wear, and wear mechanisms
CO3: Comprehend the laser processing, electrons & ion beam processing of surfaces, to characterize and evaluate coatings.
CO4: Evaluate economics in designing surface engineering processes.
CO5: Evaluate energy consumption in designing surface engineering processes.

Text Books

1. Tadeusz Burakowski and Tadeusz W, "Surface Engineering of Metals : Principals, Equipments and Technologies", CRC Press, USA, 2000.
2. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 2012.

References

1. N.V. Parthasarathy, Electroplating Handbooks, Prentice Hall, 1992
2. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
3. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice Hall of India PvtLtd , New Delhi, 2005.

Web references

- https://onlinecourses.nptel.ac.in/noc18_me66/preview
- ttps://onlinecourses.nptel.ac.in/noc19_me30/preview

BoS Chairman

Course Code : 16MEE25	Course Title: MANUFACTURE AND INSPECTION OF GEARS	
Core/Elective: Elective	L : T : P : C	3: 0: 0: 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Theory of Machines-I
- Metal Forming, Joining and casting Processes
- Metal Cutting Processes

Course Objectives

The course is intended to:

1. Specify the gear and gear material for given application
2. Explain the gear tooth generation processes such as hobbing, planning, shaping and milling
3. Explain the gear finishing processes and heat treatment processes
4. Explain the various sources of errors in gear tooth and drive and chose the instruments for measuring the errors.
5. Explain the gear tooth forming methods such as, stamping, moulding, casting powder metal, rolling and broaching.

UNIT I INTRODUCTION TO GEARS AND GEAR MATERIALS 9

Types of gears, classification, gear drawings, gearboxes, application of gears, gear production methods- an overview, involumetry.
Non-metallic, ferrous and non-ferrous gears. Properties of gear materials, selection of material for typical gears and applications – blank preparation methods for different gears, size, type and material.

UNIT II MANUFACTURE OF GEARS 9

Preforming Gear Blanks, Forming- Hobbing, Shaping, Planning, milling, Production of straight bevel gears and spiral gears, milling, and generation by straight bevel gear generator. Spiral bevel gear generator

UNIT III GEAR FINISHING AND HEAT TREATMENT OF GEARS 9

Gear finishing advantages, finishing of gears by grinding, shaving, lapping, honing methods and cold rolling of gears. Description of machines, process and process parameters
Through hardening, case hardening, flames hardening, induction hardening of gears, Nitriding of gears. Tuft riding of gears.

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UNIT IV **METROLOGY OF GEARS** **9**

Metrology of Gears: Gear tooth terminology, Sources of errors in manufacturing of gears, Measurement of tooth thickness: Gear tooth vernier, Constant chord method, Addendum comparator method and Base tangent method, Measurement of tooth profile: Tool maker's microscope or projector, Involute tester, Measurement of pitch, Measurement of run out, Lead and Backlash checking. Measurement of concentricity, Alignment of gears. Inspection of gears for hardening defects.

UNIT V **MODERN GEAR PRODUCTION METHODS** **9**

Gear production by stamping, die casting, power metal process, injection and compression Moulding in plastics. Die casting, cold and hot rolling, mass production methods, shear speed shaping. Gear broaching – Gleason. G-Trac Gear generation method, Quality of the gears.

Course Outcomes

At the end of the course students will be able to:

CO1: Specify the gear and gear material for given application
CO2: Explain the gear tooth generation processes such as hobbing, Planning, shaping and Milling
CO3: Explain the gear finishing processes and heat treatment processes
CO4: Explain the various sources of errors in gear tooth and drive and chose the instruments for measuring the errors
CO5: Explain the gear tooth forming methods such as, stamping, moulding, casting powder metal, rolling and broaching

Text Books

1. David A. Stephenson, John S. Agapiou "Metal Cutting Theory and Practice",CRC Press, 2016
2. Stephen P.Radzevich, "Dudley's Handbook of Practical Gear Design and Manufacture", CRC Press, 2012

References

1. J.R.Davis. "Gear Materials, Properties, and Manufacture" ASM International, 2005
2. HMT, "Production Technology "TMH, INDIA 2008
3. Gitin M Maitra, Handbook of Gear Design, TMH,2020.
4. Society of Manufacturing engineers, Gear Processing and Manufacturing", 2nd Edition, 1984
5. Prem H.Daryani, "The Art of Gear Fabrication", Industrial Press Inc, 2001.

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Web References

- https://www.agma.org/assets/uploads/events/GearMfgInspection-Outline.pdf
- https://onlinecourses.nptel.ac.in/noc17_mm15/preview
- https://nptel.ac.in/courses/112105126/33.
- https://nptel.ac.in/courses/112106137/pdf/2_5.pdf.
- https://nptel.ac.in/courses/112105127/pdf/LM-32.pdf.
- https://khkgears.net/gear-manufacturing/

BoS Chairman

Course Code: 16PEE02	Course Title: CLOUD MANUFACTURING AND INTERNET OF THINGS	
Core/Elective: Elective	L: T : P : C	3: 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

1. C- programming
2. Industrial engineering

Course Objectives

The course is intended to:

1. Understand the differences between traditional deployment and cloud computing
2. Explain in perspective on application scaling in cloud environment for quality metrics.
3. Describe the advanced software engineering principles and methodologies for effective Software tools and development
4. Understand constraints and opportunities of wireless and mobile networks for Internet of Things
5. Describe the basic measurement tools to determine the real-time performance Of packet based networks.

UNIT I CLOUD ARCHITECTURE BASICS 9

The Cloud -Hype cycle-metaphorical interpretation-cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, role of virtualization in enabling the cloud.

UNIT II CLOUD APPLICATION ARCHITECTURES 9

Development environments for service development; Amazon, Azure, Google App-cloud platform in industry.

UNIT III INTRODUCTION TO INTERNET OF THINGS 9

Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Cloud Computing, Communication protocols, Embedded Systems, IoT Levels and– Home, City, Environment, Energy, Retail, Logistics, Industry, health and Lifestyle

UNIT IV IOT AND M2M 9

Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG-NETCONF, YANG, SNMP NETOPEER

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UNIT V IOT PHYSICAL SERVERS AND CLOUD OFFERINGS 9

Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

Course Outcomes

At the end of the course students will be able to:

CO1: Interpret the differences between traditional deployment and cloud computing.
CO2: Identify the application scaling in cloud environment for quality metrics.
CO3: understand data analytics and cloud in the context of IoT
CO4: Define about various IOT-related protocols.
CO5: Understand Smart Objects and IoT Architectures

Text Books

1. John Rhoton ,Cloud Computing Explained: Handbook for Enterprise Implementation 2013 edition, 2013, recursive press.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

References

1. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.

Web references

- https://nptel.ac.in/courses/106105166/
- https://nptel.ac.in/courses/106105167/

BoS Chairman

Course Code: 16PEE03	Course Title: QUALITY ASSURANCE AND RELIABILITY	
Core/Elective: Elective	L: T : P : C	3: 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

1. Engineering Metrology and Measurements.
2. Production Planning and Control

Course Objectives

The course is intended to:

1. Impart the knowledge of the quality control, control charts and application and construction of various quality control charts and the Selection.
2. Study the significance of design of experiments and its application.
3. Train the students in the field of reliability and its estimation.

UNITI STATISTICAL PROCESS CONTROL 9

Quality control – Defenition – Quality Assurance Variation in process – Factors – control charts – variables XR and Xσ, - Attributes P, C and U- Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 9

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk, AQL, LTPD, AOQL, Concepts Design of single sampling plan – standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV RELIABILITY AND ITS PREDICTION 9

Life testing – Failure characteristics – Meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques – Pareto analysis. MTBF MTTF – System

BoS Chairman

reliability – OC curve Availability and Maintainability – Reliability Improvement techniques.

UNIT V FAILURE DATA ANALYSIS 9

Real time distribution, exponential, normal, log normal, gamma and weibull – reliability data requirements – Graphical evaluation.

Course Outcomes

At the end of the course students will be able to:

CO1: Describe the basic concepts involved in manufacturing process control for variables.
CO2: Describe various process control charts for attributes
CO3: Explain the concepts of acceptance sampling
CO4: Distinguish the life testing techniques, failure data analysis and mean failure rate.
CO5: Describe Pareto analysis and product design, development and life cycle concepts.

Text Books

1. Bester field D.H., "Quality Control" Prentice Hall, 7th edition 2003.
2. Amita Mitra "Fundamentals of Quality Control and Improvement" Pearson Education, 2002

References

1. Manohar Mahajan, "Statistical Quality Control" Dhanpal Rai & Sons, 2001.
2. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publications, 2004.

Web references

https://nptel.ac.in/courses/112101005/downloads/Module_5_Lecture_3_final.pdf
https://nptel.ac.in/courses/110101010/15
https://nptel.ac.in/courses/122106032/Pdf/4_1.pdf

BoS Chairman

Course Code : 16MEE20	Course Title: FLEXIBLE MANUFACTURING SYSTEMS (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3:0:0:3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Classify and distinguish FMS and other manufacturing systems
2. Explain processing stations and material handling systems used in FMS environments.
3. Understand tool management and analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.
4. Understand the concepts of group technology in FMS.
5. Design and analyze FMS using simulation and analytical techniques

UNIT I UNDERSTANDING AND CLASSIFICATION OF FMS 9

Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type Classification of FMS Layout - Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc

UNIT II PROCESSING STATIONS AND MATERIAL HANDLING SYSTEM 9

Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station.
Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS)

UNIT III MANAGEMENT TECHNOLOGY 9

Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

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UNIT IV GROUP TECHNOLOGY 9

Introduction, Definition, Reasons for Adopting Group Technology, Benefits of Group Technology Affecting Many Areas of a Company, Obstacles to Application of GT

UNIT V DESIGN OF FMS 9

Performance Evaluation of FMS, Analytical model and Simulation model of FMS, Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database

Course Outcomes

At the end of the course students will be able to:

CO1: Classify and distinguish FMS and other manufacturing systems
CO2: Explain processing stations and material handling systems used in FMS environments
CO3: Understand tool management and analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS
CO4: Understand the concepts of group technology in FMS
CO5: Design and analyze FMS using simulation and analytical techniques

Text Books

1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991
2. Groover, M.P "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt.Ltd. New Delhi 2009

References

1. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991.
2. John E Lenz "Flexible Manufacturing" Marcel Dekker Inc New York, 1989.

Web References

- https://nptel.ac.in/courses/112107143/36
- https://nptel.ac.in/courses/112104228/31

BoS Chairman

Course Code: 16MEE44	Course Title: QUALITY ENGINEERING (Common to Production, and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Metrology and Measurements.
- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Explain the need of quality and customer satisfaction.
2. Explain the basics of Quality cost with classification
3. Explain the concept of total quality management relevant to both manufacturing and service industry.
4. Explain the various tools used in Quality Engineering and Management.
5. Explain the steps used for Designing for Quality.

UNIT I INTRODUCTION 9

Introduction – Need for quality – Evolution of quality – Different Definitions and Dimensions of Quality– Concepts of Product and Service Quality– Contributions of Deming, Juran and Crosby – Barriers to Quality – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Costs of Poor quality.

UNIT II QUALITY COSTS 9

Basic Concept Quality Costs: Fitness for Use, Quality Characteristics, Parameters of Fitness for use-Quality functions, Concept of Quality assurance and Quality control, Quality costs concept, Quality cost categories, Examples of Quality cost studies, Securing the Cost figures, Pareto Analysis, Cost reduction Programs and economics of quality.

UNIT III TOTAL QUALITY MANAGEMENT 9

Total quality Management- Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Modern Quality Management Techniques-Benchmarking, QFD, Taguchi

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quality loss function TPM,Lean Manufacturing continuous improvement techniques, JIT systems, Cause and effect diagrams, Scatter diagram, Run charts, Affinity diagrams, Inter-relationship diagram, Process decision program charts, PDCA Concept

UNIT IV Quality Engineering and Management Tools 9

Quality Engineering and Management Tools, Techniques & Standards: 7 QC tools, 7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, SMED, Quality Circle, Cost of Quality Technique, Introduction to Quality Management Standards – ISO 9000, IATF 16949, ISO 14001, ISO 45001, ISO 50001 (Concept, Scope, Implementation Requirements & Barriers, and Benefits), Introduction to National and International Quality Awards.

UNIT V Designing for Quality 9

Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application (with case studies). Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitations – DOE.

Course Outcomes

At the end of the course the student will be able to:

CO1: Explain the need of quality and customer satisfaction.

CO2: Explain the basics of Quality cost with classification

CO3: Explain the concept of total quality management relevant to both manufacturing and service industry.

CO4: Explain the various tools used in Quality Engineering and Management.

CO5: Explain the steps used for Designing for Quality.

Text Books

1. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jain and A K Chitale, Khanna Publishers.
2. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Education .
3. Quality Management by Kanishka Bedi .
4. Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd.
5. Total Quality Management by K C Arora, S K Kataria & Sons.
6. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Co. (P) Ltd.

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References

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India
3. List of Open Source Software/learning

website:

1. http://www.nptel.ac.in
2. http://www.ocw.mit.edu

BoS Chairman

Course Code: 16MEE30	Course Title: ADDITIVE MANUFACTURING (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal cutting Process

Course Objectives

The course is intended to:

1. Explain the importance of Rapid Prototyping Technology
2. Select liquid based and solid based rapid prototyping.
3. Design RPT solutions for data preparation
4. Select Three Dimensional Printing
5. Design RPT solutions based on tooling.

UNIT I INTRODUCTION **6**

Introduction: Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **10**

Classification of RP systems, Fusion Deposition Modeling – Principle – process parameters –Applications. Laminated Object Manufacturing – Principle – process parameters – Applications, Stereo lithography systems – Principle – process parameters –process details – Applications.- Selective laser sintering (SLS) - Direct Metal Laser Sintering (DMLS) system – Direct Metal Deposition- Principle –process parameters –Applications-Solid ground curing.

UNIT III DATA PREPARATION FOR RAPID PROTOTYPING TECHNOLOGIES **10**

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

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UNIT IV THREE DIMENSIONAL PRINTING 10

Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies.

Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold, SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing

UNIT V RAPID TOOLING 9

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.

CO2: Select appropriate liquid based and solid based rapid prototyping systems such as Stereo lithography, Selective laser sintering, Direct Metal Laser Sintering and Direct Metal Deposition for modeling.

CO3: Design RPT solutions such as Model Slicing, direct slicing and adaptive slicing and Tool path generation for data preparation.

CO4: Select a suitable three Dimensional Printing from Selective Laser Melting and Electron Beam Melting for Shape Deposition Manufacturing for making prototype.

CO5: Design RPT solutions for automotive, aerospace and electrical industry.

Text Books

4. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Second edition, World Scientific Publishers, 2010
5. Pham,D.T. &Dimov.S.S., "Rapid manufacturing", Springer-Verlag, 2001.

References

1. Andreas Gebhardt, Hanser "Rapid prototyping", Gardener Publications, 2003.
2. LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals of Streolithography", Society of Manufacturing Engineering Dearborn, 1992.

Web References

- https://www.nde-ed.org/index_flash.htm

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Course Code: 16MEE21	**Course Title: NON-DESTRUCTIVE TESTING METHODS** (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Metrology and Measurements.

Course Objectives

The course is intended to:

1. Explain the testing procedure for Visual Inspection and Eddy Current Testing Method.
2. Explain testing procedure for Magnetic Particle Testing Method.
3. Explain testing procedure for Liquid Penetrant Testing Method.
4. Plan inspection sequence for Ultrasonic Testing Method.
5. Plan inspection sequence for Radiographic Testing Method.

UNIT I VISUAL INSPECTION AND EDDY CURRENT TESTING METHOD 9

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory- Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexiscope, Telescope and Hollography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAGNETIC PARTICLE TESTING METHOD 9

Basic Principle of magnetic particle testing(MPT)-induced magnetic fields-circular and longitudinal fields-Hysteresis curve-magnetic flux strips and coils-residual fields and demagnetization-MPT techniques-magnetization using a permanent magnet, magnetization using a Electro magnet, contact current flow method, wet and dry particle inspection methods, remote magnetic particle inspection, probe power inspection, light weight UV lamps inspection, semi automatic inspection, applications and limitations of MPT.

UNIT III LIQUID PENETRANT TESTING METHOD 9

Physical properties of liquid penetrant-penetrant testing materials-penetrants, cleaners, emlusifiers developers, lint free cloth-Basic Principle, applications and limitations of liquid penetrant testing(LPT)-different LPT methods-Post-Emulsification

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Fluorescent penetrant process, Reverse Fluorescent Dye penetrant process, Visible Dye penetrant process, Water-Emulsification visible Dye penetrant process, solvent clean visible Dye penetrant process.

UNIT IV ULTRASONIC TESTING METHOD 9

Basic properties of sound beam-sound waves-velocity of ultrasonic waves, Acoustic Impedance behaviour of ultrasonic waves-ultrasonic transducers-characteristics of ultrasonic beam, Flaw sensitivity, Beam divergence, Attenuation-Principle of ultrasonic testing methods, applications and limitations-Ultrasonic testing method-normal incident pulse echo inspection method, normal incident through transmission testing method, angle beam pulse echo inspection method.

UNIT V RADIOGRAPHIC TESTING METHOD 9

Basic Principle of Radiography-Electromagnetic radiation sources-X ray source, Gamma ray source-properties of X and Gamma rays-Radiographic Imaging-Geometrical factors- radiographic film-film density-Radiographic sensitivity-Penetrameter-Radiographic Inspection Techniques-single wall single image technique, wall penetration technique, Latitude technique-Applications and Limitations of Radiographic Inspection Techniques.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the testing procedure for Visual Inspection and Eddy Current Testing Method in Quality Assurance.

CO2: Explain testing procedure for Magnetic Particle Testing Method for Quality Assurance.

CO3: Explain testing procedure for Liquid Reentrant Testing Method for Quality Assurance.

CO4: Plan inspection sequence for Ultrasonic Testing Method for Quality Assurance.

CO5: Plan inspection sequence for Radiographic Testing Method for Quality Assurance.

Text Books

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu,"Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw-HillEducation Private Limited, 2003.

References

1. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
2. American Metals Society, "Non-Destructive Examination and Quality Control", Metals Hand Book, Vol.17, 9th Edition, Metals Park, 1989.

BoS Chairman

3. Paul Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition,New Jersey,2005.

Web References

- https://www.nde-ed.org/index_flash.htm
- http:// http://117.55.241.6/library/E-Books/NDT%20Notes.pdf
- http:// www.slideshare.net/ndtindia123/introduction-uses-of-non-destructive-testing-24377016
- http:// www.eis.hu.edu.jo/ACUploads/10526/Ultrasonic%20Testing.pdf
- http://www.hse.gov.uk/comah/sragtech/ndt2.pdf

BoS Chairman

Course Code : 16MEE22	Course Title: SUPPLY CHAIN MANAGEMENT (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3:0:0:3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Assess the potential failure modes in material storage and handling between.
2. Apply REBA/RULA techniques in storage and material handling design.
3. Design part quality for the point of consumption.
4. Design material storage and handling system.
5. Apply standardization in storage and handling work procedures.

UNIT I MATERIAL HANDLING - SYSTEMS AND FACILITIES 9

Material Handling System - Need, scope, definitions and terminologies, types, elements, Organization for logistics management and control. Introduction Process flow charting/mapping techniques.

Material Handling Facilities - Types of Material Handling Equipments (AGVs, Fork lift, prime movers, stackers, lifts etc), selection criteria for MHES. Design considerations, selection of materials. Estimation of number of facilities required; cost estimation and control. Introduction to thermoforming/injection molded crate design and manufacturing for kitting of the parts.

UNIT II ERGONOMICS IN DESIGN 9

Application of RULA & REBA in MHF design, MHF design considerations for plastic parts, painted Parts, machined parts, fragile parts, c class parts, inter-plant material movement, and in-direct areas.

UNIT III MEASURES OF MATERIAL HANDLING SYSTEM 9

Reliability, maintainability, serviceability, availability factors, Supply supports, TPM for MHF, manufacturing consideration: processes, methods and tools, assembly and dismantling of MHF, system feasibility analysis, system operational requirements, Supportability analysis, functional analysis, MTBF and MTTR for MHFs, flexibility in MHFs, traceability of MHFs and MHEs, salvaging of MHFs and MHEs

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UNIT IV STORAGE SYSTEMS 9

Creation of modern stores and storage systems: concept of stores, types of stores, storage facilities, considerations for creation of stores, estimation of docks, truck turn-around time, truck window time, inventory and types, WIP, material retention point, model store concept

UNIT V ANALYSIS OF MATERIAL TRANSPORT SYSTEMS 9

Analysis of Vehicle based system- determination of number of vehicles in AGVs and determination of delivery distance. Conveyor analysis – single direction, continuous loop and re-circulating conveyors.

Course Outcomes

At the end of the course students will be able to:

CO1: Identify the potential failure modes in material storage and handling between POM/POS to POC.
CO2: Use REBA/RULA tools and techniques to study ergonomics in storage and material handling design.
CO3: Verify produced part quality is delivered to the point of consumption.
CO4: Design material storage and handling system to prevent potential failure modes.
CO5: Develop standardized storage and handling work procedures.

Text Books

1. Mikel P.Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", PHI Publishers, 3rd Edition 2016.
2. Blanchard and Benjamin S, "Logistics Engineering and Management", 6th International Edition, Prentice Hall Inc, 2015

References

1. Christopher M, "Logistics and Supply Chain Management - Creating Value Adding Networks", Prentice Hall, 2010.
2. James M. Apple, "Plant Layout and Material Handling" John Wiley, 7th Edition, 2000.
3. Prauss L,"The Green Multiplier - a Study of Environmental Protection and Supply Chain", Antonn Rauss Limited, Palgrave Macmillan, 2005.

BoS Chairman

Course Code: 16MEE42	Course Title: INDUSTRIAL SAFETY MANAGEMENT (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal cutting Process

Course Objectives

The course is intended to:

1. Explain the importance of safety management
2. Explain the measurement and monitoring techniques
3. Explain the roles and responsibilities of Safety department
4. Describe the importance of Industrial safety acts
5. Explain the classes of fires and controlling techniques.

UNIT I INTRODUCTION TO SAFETY MANAGEMENT 9

Principles of Safety Management ,Need of safety in organisation, Occupational Health & hygiene, modern safety concept-Safe operating procedure (SOP's), Safety permits, Social and physiological effects, Behavioural based safety- aim, benefits, law and rules, Accident - Near Miss, injury, Cost of accident, Unsafe act , Unsafe condition, Environmental safety - air pollution, water pollution ,industrial noise & vibration control , Hazards & Risks, Types of Hazards and control methods, Material handling methods.

UNIT II SAFETY PERFORMANCE MONITORING 9

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, Components of safety audit, types of audit, audit methodology, permanent total disabilities, permanent partial disabilities, temporary total disabilities - Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention incident rate, accident rate, safety "t" score, safety activity rate Records of accidents, accident reports.

UNIT III SAFETY ORGANISATION 9

Role and responsibilities of management and line staffs, Supervisors and Employees, Safety committee, Motivation, budgeting for safety, safety policy, Safety Education and Training, Importance of training-identification of training needs- Training methods – programme, seminars, conferences, role of government agencies and private consulting agencies in safety training – creating awareness, awards, Safety week celebrations, safety

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posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, Personal Protective Equipment (PPE) - Requirements of PPE, Selection and Usage of PPE, Importance of IS Standard, Types of PPE

UNIT IV INDUSTRIAL LEGISLATIONS 9

Indian Factories act 1948, Tamilnadu Factories rule 1950 – Environmental protection act 1986- Indian electricity act 1910, Indian electricity rule 1956 – Indian boiler act 1923 – Workmen's compensation act 1923 – Explosive act1983 - Noise pollution rules 2000, Gas cylinder rules 2016, Hazardous waste management rules 2019.

UNIT V DISASTER MANAGEMENT AND EMERGENCY PREPAREDNESS 9

Fire properties of solid, liquid and gases – Fire triangle- fire spread - toxicity of products of Combustion - sources of ignition – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – a, b, c, d, e – fire extinguishing agents - fire stoppers, Emergency preparedness and responsibilities- ERT- On site and off site emergency plan, Mock drill Bhopal Gas tragedy - faulty handling of equipment's, failure of hoist, crane.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the importance of safety management to control the accidents, pollution and hazards.
CO2: Explain the measurement and monitoring techniques to report the safety performance.
CO3: Explain the roles and responsibilities of Safety department in an organization to eliminate the unsafe act and conditions.
CO4: Describe the importance of Industrial safety acts related to safety environment pollution in India.
CO5: Explain the classes of fires and controlling techniques and plan for an onsite and offsite emergency.

Text Books

1. Deshmukh .L.M "Industrial Safety Management" McGraw-Hill 2006.
2. C.RayAsfahl "Industrial Safety and Health management" Pearson Prentice Hall,2003

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References

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, New Delhi-1989.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
3. Subramanian.V., "The Factories Act 1948 with Tamilnadu factories rules 1950", Madras Book Agency, 21st ed., Chennai, 2000.

Web References

- http://www.icebookshop.com
- http://nptel.ac.in/courses/112107143/40

BoS Chairman

Course Code: 16PEE04	Course Title: PLANT LAYOUT AND MATERIAL HANDLING	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Computer integrated manufacturing
- Manufacturing Processes-II

Course Objective

The course is intended to:

1. Explain the equipments, Capacity, serviceability and flexibility of manufacturing Plant.
2. Explain the factors influencing product, process, fixed and combination layout of plant.
3. Select appropriate material handling system used in plant.
4. Select appropriate utilities used in plant.
5. Explain the various analysis of material handling equipments in plant.

UNIT I INTRODUCTION 9

Factors to be considered for location of plant layout - physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements.

UNIT II PLANT LAYOUT 9

Plant layout - need for layout, factors influencing product, process, fixed and combination layout - tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models machine data. Layout planning Procedure. Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.

UNIT III MATERIAL HANDLING 9

Principles, importance and scope of material handling. Planning, operation and costing principles types of material handling systems, factors influencing their choice.

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UNIT IV UTILITIES

9

Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, air conditioning and ventilation utilities. Planning and maintenance, waste handling statutory requirements. Packing and storage of materials - layout for packaging packaging machinery wrapping and packing of materials, cushion materials.

UNIT V ANALYSYS OF MATERIAL HANDLING EQUIPMENTS 9

Analysis of material handling - factors involved, motion analysis, flow analysis, graphic analysis, safety analysis, and equipment cost analysis, analysis of operation material handling surveys.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the equipments, Capacity, serviceability and flexibility of manufacturing Plant.
CO2: Explain the factors influencing product, process, fixed and combination layout of plant.
CO3: Select appropriate material handling system using in plant.
CO4: Select appropriate utilities used in plant.
CO5: Explain the various analysis of material handling equipments in plant.

Text Books

1. James,M.Apple, Plant layout and material handling, Ronald, 1977.
2. Rudenko. N., "Materials handling equipment", ELnvee Publishers, 1970.
3. Immer, I.R.Material Handling, McGraw-Hill Book Co, 1953.

References

1. Shubin and Madeheim, Plant Layout, Prentice-Hall of India, 1965.
2. James Moore, M., Plant Layout and Design, the Macmillan Company, 1963.
3. Richanrd Muther, Practical Plant Layout, McGraw Hill Ltd, 1955.

Web References

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https://nptel.ac.in/courses/112104230/30.

BoS Chairman

Course Code: 16MEE48	**Course Title: OPERATIONS RESEARCH** (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics I
- Engineering Mathematics II

Course Objectives

The course is intended to:

1. Solve linear programming problems
2. Select the optimal solution for transportation and assignment problems
3. Calculate EOQ and EBQ for manufacturing and purchase models
4. Select critical paths using CPM and PERT
5. Select the replacement policy and shortest queuing time

.UNIT I LINEAR PROGRAMMING 9

Introduction - Formulation of linear programming models – Assumptions-Graphical solution procedure – solving LPP using simplex algorithm – Degeneracy, Revised Simplex Method Duality theory - Interpretation of dual variables- Primal Dual Relationships – Role of duality in sensitivity analysis - Dual simplex method.

UNIT II TRANSPORTATION & ASSIGNMENT MODELS 9

Transportation problems, transportation simplex method– Assignment problems, Hungarian method- LP formulation of transportation and Assignment networks- Traveling sales man problem

UNIT III INVENTORY MODELS 9

Purchase model with no shortages – manufacturing model with no shortage – Purchase model with shortage – Manufacturing model with shortages –model with price breaks.

UNIT IV NETWORK MODELS 9

Maximal flow problem – Shortest route problem – Minimal spanning tree problem - Project networks, CPM, PERT, Crashing of networks- L P model for crashing , project costing and control.

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UNIT V QUEUING AND REPLACEMENT MODELS 9

Queuing theory terminology – Single server, multi server, Limited queue capacity – applications – Markov chains. Replacement models – Money value, present worth factor and discount rate.

Course Outcomes

At the end of the course students will be able to:

CO1: Solve linear programming problems with simplex and graphical methods after formulation and assumption of required parameters.

CO2: Select the optimal solution for transportation and assignment problems, based on cost, using Northwest, Least Cost, Vogals Approximation and Hungarian methods.

CO3: Calculate EOQ and EBQ for manufacturing and purchase models operating with or without shortage.

CO4: Select critical paths using CPM and PERT in projects based on minimum duration of activities.

CO5: Select the replacement policy and shortest queuing time based on economic cost for various replacement and queuing models. them in domain specific situations

Text Books

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2015.
2. R.Panneerselvam, "Operations Research", PHI, 2006

References

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley,2002
2. Hamdy A Taha, "Operations Research – An Introduction", Prentice Hall India,2003
3. Ronald L Rardin, "Optimization in Operations Research", Pearson, 2003

Web References

- http://nptel.ac.in/courses/112106134/1
- http://www.mit.edu/~orc/

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Course Code: 16MEE27	**Course Title: LEAN MANUFACTURING** (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes.

Course Objectives

The course is intended to:

1. Understand the Lean Manufacturing principles
2. Apply various Lean tools
3. Apply value stream management
4. Apply the lean principles in manufacturing and service industries
5. Evaluate various lean metrics

UNIT I INTRODUCTION TO LEAN MANUFACTURING 7

Manufacturing systems-Types-Ford Production System, Lean Manufacturing Paradigm-History of Lean Manufacturing-Traditional Vs Lean Manufacturing, TQM vs. Lean, Toyota Production System. Lean Principles-Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri-Types of wastes, Lean objectives-Need for lean manufacturing.

UNIT II LEAN TOOLS AND METHODOLOGIES 9

Problem solving tools-Cause and Effect Diagram, Pareto analysis, FMEA, Work cell and equipment management tools- Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow , GenchiGenbutsu, Milk run , Visual workplace, Quality at the source Methodologies-Pillars of Lean Manufacturing-Just in Time, Jidoka, 5S, TPM, Six sigma, DFMA, Kaizen.

UNIT III VALUE STREAM MANAGEMENT 10

Value stream Mapping-Value stream icons-Road map-Current State, Future State-Demand stage-Market Dynamics, Customer Demand; PQ Analysis; PR Analysis; Takt Time; Pitch; Finished Goods Stock, Cycle Stock Buffer Stock; Safety Stock-Flow Stage-Continuous flow, work cells, Line balancing, Standardized work, Quick change over, Autonomous maintenance, In process Super markets, Kanban systems, FIFO Lanes,

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Production Scheduling, Leveling Stage-Paced Withdrawal, Heijunka(Load Leveling), Heijunka Box, The Runner-a Case Study.

UNIT IV LEAN IMPLEMENTATION 10

Training Stage-Management Commitment, Identify the value stream manager/Champion and core Implementation team Members, Training of team members, Planning stage-Customer Focus, Go to the floor, Hosin Planning, Brain storming, Prepare Tree Diagram, Select the cross functional team, Prepare project plan, Improvement stage-Production and Productivity-Operator, Process, Machinery and Equipment, Work place Organization, Inventory management, Planning and Procurement of Materials, A case study on Lean implementation in manufacturing and service industries.

UNIT V LEAN METRICS 9

Lean Metrics-the fundamentals, steps in identifying Lean Metrics, WIP inventory, Total Product cycle time, Total value stream lead time, On time delivery, Defective PPM, Uptime, OEE, Throughput rate, Through put yield, Utilization rate, Lean Manufacturing assessment-Radar Chart- a case study.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the Lean Manufacturing principles such as -Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri to eliminate the waste

CO2: Design manufacturing solutions based on various Lean tools and methodologies such as Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow .

CO3: Prepare value stream maps such Current state, Future state mapping, Standardized work, Quick change over, Autonomous maintenance to eliminate the non value added activities.

CO4: Design manufacturing solutions for manufacturing and service industries based on Hosin Planning.

CO5: Compare various lean metrics such as Lead time, Cycle Time, through put time, PPM, Uptime, OEE, Throughput rate, Through put yield for Lean assessment.

Text Books

1. Don Tapping, Tom Luyster, and Tom Shuker, "Value stream Management Eight steps to planning", Mapping and sustaining Lean Improvements, Productivity Press,New York, ,2012.
2. N.Gopalakrishnan, "Simplified Lean Manufacture Elements, Rules", Tools and implementation, PHI Learning, New Delhi, 2010.

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References

1. James P. Womack, Daniel T Jones, Daniel Ross "The Machine That Change the world", Free Press trade paperback edition, U.S.A, 2007.
2. Ronald G. Askin& Jeffrey B.Goldberg, "Design and Analysis of Lean Production Systems",2003, John Wiley & Sons,2003.
3. Rother M. and Shook J, "Learning to See: Value Stream Mapping to Add Value and Eliminate Muda" , Lean Enterprise Institute, Brookline, MA,1999.

Web References

- https:// www.learning –to-see.co.uk.
- https://www.lean.org.
- https://www.leanproduction.com.

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Course Code: 16MEE47	Course Title: ENTREPRENEURSHIP DEVELOPMENT (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal cutting Process

Course Objectives

The course is intended to:

1. Describe the requirement of entrepreneurship.
2. Explain the different motivational theories and government policies.
3. Classify the types of enterprises
4. Explain the various processes in managing an enterprise
5. Explain the government norms and policies

UNIT I ENTREPRENEURSHIP 9

Definition, requirements to be an entrepreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

UNIT II ENTREPRENEURIAL MOTIVATION 9

Motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

UNIT III TYPES OF ENTERPRISES AND OWNERSHIP STRUCTURE 9

Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance.

UNIT IV MANAGEMENT OF ENTERPRISES 9

objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection, etc.; marketing and organizational dimension of enterprises; enterprise financing : raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis, balance sheet its analysis..

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UNIT V INSTITUTIONAL SUPPORT AND POLICIES 9

Institutional support towards the development of entrepreneurship in India, Technical consultancy organizations, government policies(MSME) for small scale enterprises.

Course Outcomes

At the end of the course students will be able to:

CO1: Describe the requirements for entrepreneurship
CO2: Explain different motivational theories and policies for entrepreneur development
CO3: Explain the types of enterprises and ownership structure
CO4: Explain the various processes in managing an enterprise
CO5: Explain the government norms and policies that govern small scale enterprises

Text Books

1. Ram Chandran, "Entrepreneurial Development", Tata McGraw Hill, New Delhi, 2008.
2. Khanka, S S. "Entrepreneurial Development", S Chand & Company Ltd. New Delhi, 2007.

Reference Books

1. Saini, J. S., "Entrepreneurial Development Programmes and Practices", Deep & Deep Publications (P), Ltd, 2001.
2. Badhai, B "Entrepreneurship for Engineers", DhanpatRai& co. (p) Ltd,2013.
3. Desai, Vasant, "Project Management and Entrepreneurship", Himalayan Publishing House, Mumbai, 2013.

Web References

- http://www.ediindia.org/

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Course Code : 16MEE26	Course Title: MICRO AND NANO MANUFACTURING (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type :Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course:

- Metal Forming, Joining and casting Processes
- Metal Cutting Processes
- Material Science

Course Objectives

The course is intended to:

1. Understand the properties, design and behaviour of various micro-materials.
2. Understand the concept of various micro fabrication processes.
3. Impart the principles of different micro machining process
4. Understand the principles and applications of Micro Electro Mechanical Fabrication Systems.
5. Understand the properties, structures and fabrication methods

UNIT I MICROMECHANICS 9

Introduction to Micro System design - Material properties - micro fabrication Technologies. Structural behavior - sensing methods - micro scale transport – feedback systems - Microstructure of materials - its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site – ferroelectric and diffusional phase transformations - twinning and domain patterns - smart materials.

UNIT II MICRO-FABRICATION 8

Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining-Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer- devices.

UNIT III MECHANICAL MICRO-MACHINING 10

Theory of micromachining-Chip formation-size effect in micromachining-micro-turning, micro- milling, micro-drilling- Micromachining tool design-Precision Grinding-Partial ductile mode grinding-Ultra precision grinding- Binder less wheel – Free form optics

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UNIT IV MICRO ELECTRO MECHANICAL SYSTEM FABRICATION 9

Introduction – advance in Microelectronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS

UNIT V NANO TECHNOLOGY 9

Classification of nano structures – effect of the nanometre length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process – nano positioning systems.

Course Outcomes

At the end of the course students will be able to:

CO1: Understand the properties, design and behaviour of various micro-materials.
CO2: Understand the concept of various micro fabrication processes.
CO3: Impart the principles of different micro machining process
CO4: Understand the principles and applications of Micro Electro Mechanical Fabrication Systems.
CO5: Understand the properties, structures and fabrication methods

Text Books

1. Sámi Franssila, "Introduction to Micro Fabrication", John Wiley and sons Ltd., UK, 2004,
2. Jain V.K, "Micro manufacturing Processes", CRC Press, 2012

References

1. Madore J, "Fundamental of Micro fabrication", CRC Press, 2002.
2. Mark J. Jackson, "Micro fabrication and Nanomanufacturing", CRC Press, 2006.
3. Peter Van Zant, "Microchip fabrication", McGraw Hill, 2004.

Web References

- https://en.wikipedia.org/wiki/Microfabrication
- http://www.micromanufacturing.net/didactico/Desarollo/microforming/1-introduction

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Course Code: 16PEE05	Course Title: ARTIFICIAL INTELLIGENCE	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- C-Programming.
- Computer integrated manufacturing.

Course Objective

The course is intended to:

1. Describe the agent type and behavior
2. Analyze the efficiency of various searching techniques
3. Apply Inference rules to the given Knowledge Base
4. Choose the appropriate planning technique
5. Explain the application of Artificial Intelligence techniques

UNIT I INTELLIGENT AGENTS 9

Foundation and History of artificial Intelligence - Agents and Environments — Nature of environments — Structure of Agents

UNIT II PROBLEM AND SEARCHING 9

Problem Solving agents — Measuring problem solving performance — Uninformed search strategies: BFS, DFS, DLS, IDS, Bidirectional search –- Informed Search strategies : Greedy BFS — A* search - Heuristic function — Local search algorithms — Online search agent —Constraint satisfaction Problem —Backtracking search for CSP - Adversarial search

UNIT III KNOWLEDGE AND REASONING 9

Logical Agents — Propositional Logic — Reasoning patterns — resolution — Forward and Backward chaining — First Order Logic — Syntax and Semantics of FOL — using First Order Logic — Knowledge Engineering in FOL — Inference in FOL- Unification and Lifting — Forward and Backward chaining — Resolution

UNIT IV PLANNING 9

Classical Planning — Planning as State space search — Planning and acting in Real world and Non deterministic domains - Hierarchical planning - Multiage planning

UNIT V APPLICATIONS 9

Natural Language processing — Language Model — Text Classification - Information retrieval - Information extraction — Speech recognition

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Course Outcomes

At the end of the course students will be able to:

CO1: Describe the type and behavior for a given agent.
CO2: Analyze the efficiency of various searching techniques for solving a problem
CO3: Apply Inference rules to the given Knowledge Base for theorem proving
CO4: Choose the appropriate planning technique to solve the given problem.
CO5: Explain the application of Artificial Intelligence techniques in Real world system.

Text Books

1. Stuart Russell, Peter Norvig, "Artificial Intelligence — A Modern Approach', Prentice Hall, Third Edition, 2010.

Reference Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, Second Edition, 2003.
2. Patrick Henry Winston, "Artificial Intelligence', Pearson Education / PHI, Third Edition, 2004.

Web References

1. Tool: SWI-Prolog http://www.swi-prolog.org/download http://www.swi-prolog.org/pldoc/man?section=quickstart
2. AIMA (Artificial Intelligence: A Modern Approach) http://aima.cs.berkeley.edu/ - Text Book followed http://aima.cs.berkeley.edu/code.html - online code repository C++, Java, Python, LISP
3. ELearning courses from IITs and IISC
http://nptel.ac.in/video.php?subjectId=106105079 — Video Lecture by Prof P. Dasgupta

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Course Code : 16MEE24	Course Title: NANO MATERIALS SYNTHESIS AND APPLICATIONS	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course:

- Material science

Course Objectives

The course is intended to:

1. Explain the basic of nano technology.
2. Describe various dimensional structures of nano materials.
3. Explain the chemical synthesis of nanostructures.
4. Explain physical synthesis of nanostructures
5. Explain about energy applications of nanomaterials

UNIT I INTRODUCTION TO NANO TECHNOLOGY 9

History of nano science- Terminologies used in nano science- Influence of size reduction on thermal, electrical, mechanical, optical and magnetic properties of nanomaterials- surface area and aspect ratio of nanomaterials.

UNIT II NANOSTRUCTURES AND ITS CLASSIFICATION 9

Classifications of nanomaterials- Zero dimensional, one-dimensional, two dimensional and three dimensional nanostructures – Core shell nanoparticles – Kinetics in nano structured materials- multilayer thin films and nano composites.

UNIT III CHEMICAL SYNTHESIS OF NANOSTRUCTURES 9

Sol gel processing- Precipitation, Solvothermal, hydrothermal, spray pyrolysis, Electro spraying and spin coating methods of synthesis of different nanostructures- surfactant assisted synthesis of nanostructures.

UNIT IV PHYSICAL SYNTHESIS OF NANOSTRUCTURES 9

Ball milling- Vapour deposition and different types of epitaxial growth techniques (CVD, MOCVD, MBE, ALD)- pulsed laser deposition, Magnetron sputtering- Lithography: Photo/UV/EB/ FIB techniques, Dip pen nanolithography.

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UNIT V ENERGY APPLICATIONS OF NANOMATERIALS 9

Challenges in energy- conventional and unconventional fissile fuels- nanotechnology in fuel production- Renewable energy sources- photovoltacies hydrogen production- fuel cells- thermoelectricity- Implementation of renewable energy technologies.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the properties of nanomaterials based on size reduction.
CO2: Identify the structure of nanomaterials and examine its kinetics.
CO3: Compare the different chemical synthesis techniques of nanostructure formation in materials.
CO4: Describe the various physical methods of nanostructure formation.
CO5: Explain the basic concepts involved in energy systems and to explore applications of nano technology.

Text Books

1. T. Pradeep, Nano "The essentials understanding nanoscience and nanotechnology", McGraw Hill, 2009.
2. Javier Garcia- Martinez, "Nanotechnology for the energy challenge", Wiley- VCH verlag GmbH & Co, 2010.

References

1. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
2. A.S. Edelstein and R C. Cammarata, Nanomaterials: "Synthesis, Properties & Applications" , Institute of Physics Pub., 1998.

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Course Code: 16PEE06	Course Title: PRODUCTION MANAGEMENT	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- .Production planning and cost Estimation
- Operation Research

Course Objective

The course is intended to:

1. Select appropriate principles of management and personnel management in production management
2. Select appropriate process of inventory in production management
3. Choose appropriate Operations selection in production management
4. Explain the Financial strategies used in production management
5. Explain the Marketing methodologies in production management.

UNIT I PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT 9

General principles of management – management functions – organization – types – comparison –functions of personnel management – recruitment training leadership/motivation – communication –Conflict industrial relations – trade union.

UNIT II INVENTORY MANAGEMENT 9

Purpose of Inventory – Cost related to inventors – Basic EOQ model – variations in EOQ model –Finite Production quality discounts – ABC Analysis – MRP Analysis.

UNIT III OPERATIONS MANAGEMENT 9

Plant Location – Layout – Materials Handling – Method Study – Time Study – Ergonomics –Aggregate Planning – Value Analysis.

UNIT IV FINANCIAL MANAGEMENT 9

Capital – Types – sources – break even analysis – financial statements – income statement – balance– balance sheet – capital budgeting – working capital management – inventory pricing.

UNIT V MARKETING MANAGEMENT 9

Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research market research techniques.

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Course Outcomes

At the end of the course students will be able to:

CO1: Select appropriate principles of management and personnel management in production management

CO2: Select appropriate process of inventory in production management

CO3: Choose appropriate Operations selection in production management

CO4: Explain the Financial strategies used in production management

CO5 Explain the Marketing methodologies in production management.

Text Books

1. Kesavan. R., C.Elanchezhian and T.Sundar Selwyn, "Engineering management", Eswar Press,

2. Panneerselvam. K., "Production and Operations Management", Prentice Hall of India, 2003.

References

1. Koont and G'donnel, "Essentials of Management", McGraw Hill 1992.

2. Philips Kotler, "Principles of Marketing", Prentice Hall of India, 1995

3. I.M. Pandey, "Financial Management", Vikas Publishing house, 1995

4. K.K.Ahuja, "Personal Management", Kalyane Publication 1992

5. Martand T. Telesand, "Industrial and Business Management", S.Chand & Co., 2001

Web References

https://onlinelibrary.wiley.com/journal/19375956

https://www.britannica.com/technology/production-management

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Course Code: 16MEE41	Course Title: TOTAL PRODUCTIVE MAINTENANCE (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes

Course Objectives

The course is intended to:

1. Describe modern maintenance concepts and practices
2. Apply analytical tools in maintenance management
3. Apply Reliability Centered Maintenance for industrial systems
4. Illustrate TPM and global trends in maintenance management
5. Demonstrate simple instruments used for condition monitoring

UNIT I MODERN MAINTENANCE CONCEPTS AND PRACTICES 9

Maintenance definition –Maintenance management – Maintenance Concepts: Objectives, Organization and Functions of Maintenance, Maintenance strategies, Types of Maintenance – Maintenance systems – (Planned, Unplanned / Breakdown, Corrective, Opportunistic, Routine, Preventive, Predictive, Condition based maintenance systems),Maintenance planning and scheduling, Maintenance Logistics, Human factors in Maintenance and Staffing methods, Maintenance manuals, Maintenance costs

UNIT II ANALYTICAL TOOLS IN MAINTENANCE MANAGEMENT 9

Failure Data Analysis, MTBF,MTTF, Useful life-Survival curves, Repair time, Breakdown time distributions- Poisson's, Normal, Exponential, Availability, Reliability, Maintainability, Maintainability prediction – System effectiveness- Overhaul / Repair / Replace maintenance policy, Queuing applications, simulation, spare parts management, Replacement Decisions: Optimal interval between preventive replacements, Overall Equipment Effectiveness

UNIT III RELIABILITY CENTERED MAINTENANCE 9

Reliability Centered Maintenance (RCM), Objectives and function, Steps in RCM implementation, steps in RCM analysis, System selection, Tero technology – RCM effectiveness indicators, RCM tasks Proactive Maintenance, Reliability models – System reliability- Series, Parallel and mixed configuration, System reliability determination; Reliability improvement, Scheduled restoration and scheduled

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discard, The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams.

UNIT IV TPM AND GLOBAL TRENDS 9

Concept of TPM, Characteristics of TPM, Zero breakdown concepts, Zero Defects and TPM, FMECA – Maintainability prediction– Design for maintainability, Maximizing equipment effectiveness, Autonomous maintenance program, Five pillars of TPM, TPM Small group activities. Implementing TPM.Philosophy / Indications of TPM. TPM Development - Preparation phase, Master Plan, Initiatives, Promotion, Planning, Organization, Awareness, Training, Establishment of basic policies and goals, TPM organization, Implementation phase; Consolidation phase. Measuring TPM effectiveness: Measuring TPM effectiveness Indicators, Plant effectiveness and Measuring; TPM Benefits and Global trend

UNIT V CONDITION MONITORING IN MAINTENANCE 9

Condition Based Maintenance: Machine signatures, Signature Analysis-MMIS Expert systems, Temperature noise, vibration and wear particle analysis, on line and off line techniques. Online Monitoring Condition Monitoring Techniques, Vibration Monitoring and Signature Analysis. Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control, Case Studies in Maintenance, Measurement and benchmarking of performance, MIS for maintenance.

Course Outcomes

At the end of the course students will be able to:

CO1: Describe modern maintenance concepts and practices
CO2: Apply analytical tools in maintenance management
CO3: Apply Reliability Centered Maintenance for industrial systems
CO4: Illustrate TPM and global trends in maintenance management
CO5: Demonstrate use of simple instruments used for condition monitoring in maintenance

Text Books

1.Seiichi Nakajima, "Introduction to TPM", Productivity Press, Chennai, 1998.
2.Gopalakrishnan, P. and Banerji, A.K., "Maintenance and Spare Parts Management", Prentice – Hall of India Pvt. Ltd., 2013.

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References

1. Goto, F., "Equipment planning for TPM Maintenance Prevention Design", Productivity Press, 1992.
2. David J. Sumanth, "Total Productivity Management : A Systematic and Quantitative Approach to Compete in Quality, Price and Time", Productivity Press, 1997

Web References

- http://www.plant-maintenance.com/articles/tpm_intro.pdf
- http:// www.ame.org/sites/default/files/TPM-introduction-AME.pdf

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Course Code: 16MEE49	Course Title: ENGINEERING ECONOMICS AND COST ANALYSIS (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	**L : T : P : C**	3 : 0 : 0 : 3
Type: Theory	**Total Contact Hours:**	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics-I
- Metal Cutting Processes

Course Objective

The course is intended to

1. Calculate the breakeven point
2. Application of interest formula
3. Comparison of economic alternatives
4. Replacement analysis of equipment.
5. Calculate depreciation of an equipment

UNIT I INTRODUCTION TO ECONOMICS **8**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

UNIT II VALUE ENGINEERING **10**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods with problems.

UNIT III CASH FLOW MANAGEMENT **9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated

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cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case study

Course Outcomes

At the end of the course students will be able to:

CO1: Categorize different cost and calculate the breakeven point for a given business situation

CO2: Apply different interest formulae and their application in decision making process.

CO3: Evaluate present value, future value and annual worth analysis on one or more economic alternatives.

CO4: Determine the economic value of an asset and develop a better replacement policy for a given equipment.

CO5: Evaluate the depreciation of equipment per period.

Text Books

1. Panneerselvam R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2014
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.

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References

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2010.
3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1990.

Web References

- https://en.wikipedia.org/wiki/Engineering_economics
  https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

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Course Code: 16MEE50	Course Title: PROBABILITY AND STATISTICS (Common to Production,Automobile and Mechanical)	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics I & II

Course Objectives

The course is intended to:

1. Calculate the moments of the discrete and continuous random variables.
2. Apply the discrete and continuous probability distributions to real life phenomena
3. Use sample mean and variance to test small and large samples
4. Test the samples based on the analysis of variance for design experiments.
5. Compute Correlation, Regression Co-efficient and Control Charts for the given data

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Sample spaces – Events - Probability Axioms – Conditional Probability – Independent Events – Baye's Formula.
Random Variables : Distributions Functions – Marginal Distributions – Conditional Distributions – Expectation – Conditional Expectation and Conditional Variance – Moments - Moment Generating Functions.

UNIT II PROBABILITY DISTRIBUTION 9

Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems) and Chebyshev's inequality (Simple problems).

UNIT III TEST OF HYPOTHESIS 9

Tests for Means , Variances and proportions – Tests for Means , Variances and Attributes using t , F , Chi – Square distribution – Interval estimation for mean, Standard deviation – Proportion.

UNIT IV ANALYSIS OF VARIANCE 9

One way classification, Two way classification and Latin square design (Only problems).

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UNIT V INSTALLATION AND SERVICING 9

Statistical basis for control charts – Control limits – Control charts for variables : X , R Charts – Control chart for defective : p , np Chart - Control chart for defects : c charts. Correlation – Regression – Multiple and Partial Correlation – Partial Regression (Problems Only)

Course Outcomes

At the end of the course students will be able to:

CO1: Calculate the moments of the discrete and continuous random variables.

CO2: Apply the discrete and continuous probability distributions to real life phenomena

CO3: Use sample mean and variance to test small and large samples

CO4: Test the samples based on the analysis of variance for design experiments.

CO5: Compute Correlation, Regression Co-efficient and Control Charts for the given data

Text Book

1. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand& Sons, New Delhi – 1999.
2. S. P. Gupta, Statistical Methods , Sultan Chand & Sons , New Delhi, 1999.

References

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2. T. Veerarajan,Probability , Statistics and Random Process , Tata McGraw Hill Publishing Company Ltd., New Delhi – 2003.
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