POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI
Choice Based Credit System (CBCS)
Scheme of Teaching and Examination AY 2024 – 25 - (Effective from the academic year 2021 – 22)

V Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawing	Self Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1.	HSMC	22HU51	Entrepreneurship, Management and Finance	Humanities Dept.	3	0	0		03	50	50	100	3
2.	IPCC	22ME52	Internal Combustion Engine	Respective Dept.	3	0	2		03	50	50	100	4
3.	PC	22ME53	Design of Machine Elements-I		3	2	0		03	50	50	100	4
4.	PCCL	22MEL54	Computer Aided Machine Drawing (CAMD)		0	0	2		03	50	50	100	1
5.	PEC	22ME55X	Elective –I		3	0	0		03	50	50	100	3
6.	PROJ	22MEMP56	Mini Project		0	0	4			50		50	2
7.	AEC	22RMI57	Research Methodology and IPR	Any Department	3	0	0		03	50	50	100	3
8.	BSC	22ES58	Environmental Studies	TD:CV/Env/Chem PSB:CV	2	0	0		03	50	50	100	2
9.	NCMC	22NS59	Mandatory Course	NSS coordinator	0	0	2			50		50	0
		22PH59	Mandatory Course	Physical Education Director									
		22YO59	Mandatory Course	Yoga Teacher									
Total					**17**	**02**	**10**			**450**	**350**	**800**	**22**

Elective –I					
Sl.No.	Course code	Course Title	Sl.No.	Course code	Course Title
1.	22ME551	Refrigeration and Air Conditioning	3	22ME553	Machine Tool design
2.	22ME552	Operation Management	4	22ME554	Robotics and Robot Applications

Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K:**The letter in the course code indicates common total the stream of engineering. **PROJ**: Project/ Mini Project. **PEC**: Professional Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as(3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE).However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering / Technology(B.E./B.Tech.)2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree.Theeventsshallbeappropriatelyscheduledbythecollegesandthesameshallbereflectedin the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented / hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems / applications etc.Based on the ability /abilities of the student /sand recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIEprocedureforMini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25.The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: ContinuousInternalEvaluationshallbegroup-wiseatthecollegelevelwiththeparticipationofalltheguidesoftheproject.

The CIE marks awarded for the Mini-project shall be based on the evaluation of the project report, project presentation skill, and question and answer session in theratio50:25:25.Themarks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course.The minimum number of students' strengths for offering a professional elective is 10.However,this conditional shall not be applicable to cases where the admission to the program is less than10.

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VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1.	IPCC	22ME61	Heat and Mass Transfer	Respective Dept.	3	0	2		03	50	50	100	4
2.	PCC	22ME62	Design of Machine Elements - II		3	2	0		03	50	50	100	4
3.	PEC	22ME63x	Elective –II		3	0	0		03	50	50	100	3
4.	OEC	22MEOE64x	Open Elective –I		3	0	0		03	50	50	100	3
5.	PROJ	22ME65	Major Project Phase - I		0	0	4		03	50	--	50	2
6.	PCCL	22MEL66	Manufacturing Process-II Lab		0	0	2		03	50	50	100	1
7.	AEC	22IKSAE67	Indian Knowledge System		1	0	0		02	50	50	100	1
					0	0	2		03				
8.	NCMC	22NS68	Mandatory Course	NSS coordinator	0	0	2			50		50	0
		22PH68	Mandatory Course	Physical Education Director									
		22YO68	Mandatory Course	Yoga Teacher									
Total:					**12**	**02**	**12**			**400**	**300**	**700**	**18**

Elective –II					
Sl.No	Course code	Course Title	Sl.No.	Course code	Course Title
1.	22ME631	Operations Research	3	22ME633	Finite Element Method
2.	22ME632	Automatic control engineering	4	22ME634	Alternative Fuels

Open Elective Course	
22MEOE641	Industrial Engineering and Ergonomics

Ability Enhancement Course/Skill Enhancement Course-V	
22XXAE671	Indian Knowledge System

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation,

SEE:: The letter in the course code indicates common to all the stream of engineering. **PROJ**: Project/Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase-I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L: T: P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering/Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semesters to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall n ot be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multi disciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10.However,this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/Advisor/Mentor.The minimum numbers of students'strength for offering Open Elective Course is10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I: Students have to discuss with the mentor/guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

ENTREPRENEURSHIP, MANAGEMENT AND FINANCE				
Subject Code	22HU51	Credits	03	CIE: 50
Number of Lecture Hours/ Week (L:T:P)	**3:0:0Hrs**			SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03

Prerequisite :

Course Objectives :

To enable the students to obtain the basic knowledge about Entrepreneurship and management and finance in the following topics:

- The Meaning, Functions, Characteristics, Types, Role and Barriers of
- Entrepreneurship,. Government Support for Entrepreneurship
- Management – Meaning, nature, characteristics, scope , functions, role etc and
- Engineers social responsibility and ethics
- Preparation of Project and Source of Finance
- Fundamentals of Financial Accounting
- Personnel and Material Management, Inventory Control

Modules	Hours
Module –I ENTREPRENEUR : Meaning of Entrepreneur; Functions of an Entrepreneur; Characteristics of an entrepreneur , Types of Entrepreneur; Intrapreneurs – an emerging class ; Role of Entrepreneurs in economic development; Barriers to entrepreneurship, Government Support for Innovation and Entrepreneurship in India - Startup-India, Make-in-India, PMMY, AIM , STEP, BIRAC, Stand-up India, TREAD	**8 Hours**
Module –II MANAGEMENT: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management, Levels of Management, Henry Fayol - 14 Principles to Management , McKinsey's 7-S Model, Management by objective(MBO) – Meaning, process of MBO, benefits and drawbacks of MBO.	**8 Hours**
Module –III PREPARATION OF PROJECT AND SOURCE OF FINANCE: PREPARATION OF PROJECT: Meaning of project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; SOURCE OF FINANCE: Long Term Sources(Equity, Preference, Debt Capital, Debentures, loan from Financial Institutions etc) and Short Term Source(Loan from commercial banks, Trade Credit, Customer Advances etc)	**8 Hours**
Module –IV FUNDAMENTALS OF FINANCIAL ACCOUNTING: Definition, Scope and Functions of Accounting , Accounting Concepts and Conventions: Golden rules of Accounting, Final Accounts - Trading and Profit and Loss Account, Balance sheet	**9 Hours**

Module –V	
PERSONNEL MANAGEMENT: Functions of Personnel Management, Recruitment, Selection and Training, Wages, Salary and Incentives MATERIAL MANAGEMENT AND INVENTORY CONTROL: Meaning, Scope and Objects of Material Management. Inventory Control- Meaning and Functions of Inventory control ; Economic Order Quantity(EOQ) and various stock level (Re-order level, Minimum level, Maximum level, Average level and Danger level)	**9 Hours**

Question paper pattern:

1. Total of Ten Questions with two from each MODULE to be set covering the entire syllabus.
2. Five full questions are to be answered choosing at least one from each MODULE.
3. Each question should not have more than 3 sub divisions.

Text books:

1. Financial Accounting -B S RAMAN- United Publishers Manglore, Maheswar S N & Maheswari S K- Vikas Publishing House. January 2018
2. Management & Entrepreneurship- K R Phaneesh- Sudha Publications January 2018 ,Prof Manjunatha & Amit kumar G – laxmi Publication , January 2011. Veerbhadrappa Havina -Published by New Age International (P) Ltd., 2009.
3. Principles of Management First Edition (English, G. Murugesan), Laxmi Publications – New Delhi
4. Management by Objectives (Mbo) in Enterprises: 21 December 2018 by Dr Wazir Ali Khan

Reference Books:

1. Industrial Organization & Engineering Economics-T R Banga & S C Sharma- Khanna Publishers, Delhi.
2. NPTEL: Entrepreneurship: Prof. C Bhaktavatsala Rao, Department of Management Studies, IIT Madras, https://nptel.ac.in/courses/110/106/110106141/
3. https://www.businessmanagementideas.com/notes/management-notes/notes-on-management-in-an-organisation/4669
4. https://vskub.ac.in/wp-content/uploads/2020/04/Unit-5-ppmb.pdf

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

Course Outcomes
CO1: Develop Entrepreneurship skills
CO2: Apply the concepts of management and Management By Objective(MBO)
CO3: Prepare project report & choose different Source of Finance.
CO4: Apply Fundamentals of Financial Accounting and interpret the final accounts
CO5: Apply personnel management skills, Material and inventory control techniques

INTERNAL COMBUSTION ENGINES				
Subject Code	22ME52	Credits	04	CIE: 50
Number of Lecture Hours/ Week	3 (Theory) + 2(Practical)			SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03

COURSE OBJECTIVES:

1. Different types of internal combustion engines and the parameters that define engine performance and analyze performance and efficiency aspects.
2. Importance fuel-air mixture preparation processes and fuel supply system in
3. gasoline and diesel engines.
4. Spark-ignition (SI) and compression ignition (CI) engine combustion, SI and CI engine knock, and combustion chambers.
5. Overall engine operating characteristics: supercharging, turbo-charging, variable valve-timing, gasoline direct injection, multi fuel and dual fuel engine.

	Teaching Hours
Module-I **INTRODUCTION TO I.C. ENGINES:** Introduction, Basic engine components, Classification of I.C. Engines. Valve timing diagram for high & low speed engine, Port timing diagram. **FUEL AIR CYCLES:** Fuel Air Cycles, Variations in specific heat, Dissociation, Simple problems.	**8 Hours**
Module-II **FUEL SYSTEMS FOR S.I. ENGINES:** Elementary and Complete carburetor Derivation for calculation of A/F ratio. Multi Point Fuel injection system (MPFI) (Numerical on calculations of main dimension of carburetor). **COMBUSTION IN S. I. ENGINES:** Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, abnormal combustion, operating variables on detonation, Requirements of combustion chambers of S.I. Engines and its types.	**9Hours**
Module-III **REQUIREMENTS OF INJECTION SYSTEM:** Fuel metering, pressurizing and injecting system, Types of. System- Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles, Governing of CI Engines, Pneumatic governors. **COMBUSTION IN C.I. ENGINES:** Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion-Diesel knock, operating variables on diesel knock, Comparison of abnormal combustion in S I and C I engines, Requirements of combustion chambers for C.I. engines and its types.	**8 Hours**
Module-IV **SUPERCHARGING:** Purpose of supercharging, Thermodynamic cycle of supercharged engine, Types of superchargers, Turbo charging, Advantages and disadvantages, Limits of supercharging for S.I. and C.I. Engines. **PERFORMANCE AND TESTING OF ENGINES:** Performance parameters, determination of IP, BP, FP, Mean effective pressure, Fuel consumption, Air Consumption, Engine efficiencies, Performance characteristics, Energy balance.	**9 Hours**

Module V	
ALTERNATIVE FUELS FOR I C ENGINES: Ethanol,Methanol, Hydrogen,Natural Gas, LPG,CNG,DME,DEE,Bio gas and Bio-diesel,Properties,advantages and disadvantages. **ENGINE EMISSION AND CONTROL:** S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- EGR.	**8 Hours**

Question paper pattern:

1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2. Five full questions are to be answered selecting at least One full question from each Module.
3. Each question should not have more than 3 sub divisions.

Text books:

1. Internal Combustion Engines, V. Ganesan, Tata Mc-Graw Hill Publications, 4th Edition, 2012.
2. Internal Combustion Engines, M. L. Mathur and R. P. Sharma, DhanpatRai Publications, 2014.

Reference Books:

1. Internal Combustion Engine Fundamentals, John B. Heywood, Mc-Graw Hill Education India Limited, 2011.
2. Engineering Fundamentals of the Internal Combustion Engines, Willard W. Pulkrabek. Pearson Education, 2nd Edition, 2015.
3. A Text Book of Internal Combustion Engines, R.K. Rajput, Laxmi Publishers, 2007.

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Able to apply knowledge of basic I C Engine and cycles of operation.
CO2	Able to apply effectively the various types carburetors and combustion phenomena in SI engines.
CO3	Interpret fuel supply systems and combustion processes in CI Engines
CO4	To evaluate Basic performance parameters of I.C.Engine and study the supercharging.
CO5	Examine different alternative fuels for IC Engines and Students can effectively contribute towards reduction in emission which has a severe impact on the environment.

INTERNAL COMBUSTION ENGINES LAB

PREREQUISITE:

1. The student should know the fundamentals of IC Engines
2. Should aware of performance, emission and combustion terms.
3. Should have profound knowledge of instruments**.**

COURSE OBJECTIVES:

1. To describe the performance and operating characteristics of Internal Combustion Engines
2. To explain the parts and complete knowledge of type of fuels used in IC engines and the fuel supply systems.
3. To describe combustion process phenomena in IC engines.
4. To explain the different methods of performance analysis of IC engines.
5. To explain the effects of exhaust emission on human health and different pollution norms

Modules

Module-I

(Group Experiments)

Performance tests on I C Engines:

Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for

1. Four stroke Diesel Engine
2. Four stroke Petrol Engine
3. Multi-cylinder Diesel/Petrol Engine (Morse Test)
4. Variable Compression Ratio I C Engine.

Module-II

(Individual Experiments)

Fuels and Lubricants Testing:

1. Determination of Flash point and Fire point of lubricating oil using Abel apparatus and Pensky Martin apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolts, Torsion Viscometers.
4. Valve, Timing/ port opening diagram of an I C Engine (4 stroke/ 2 stroke).

DESIGN OF MACHINE ELEMENTS-I			
Subject Code	**22ME53**	**Credits: 04**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory) + 2(Tutorial)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE: 1) Mathematical methods such as Differentiation, Integration, Linear differential equations, Geometry of plane surfaces 2) Physics: Units and dimensions, 3) Mechanics of materials: Stress, strain, Elastic constants, Types of loads, Centre of gravity and Moment of inertia of basic planes, Resolution of forces.

COURSE OBJECTIVES:

1. To introduce to codes and standards, safe design practices, different types of stresses and computation of tensile and compressive stresses for the given static load conditions on machine elements.
2. To be able to compute the stress concentration at different types of stress raisers for different types of load conditions and to design the machine elements subjected fatigue loading.
3. To be able to select suitable mechanical joints, couplings, keys for given load conditions and design economical and safe shafts, keys and couplings for the given operating conditions.
4. To design the suitable power transmission system using belts and pulleys and power screws based on the specified operating conditions.
5. To be able to design suitable brakes and clutches from safety and economy considerations for the given service conditions.

Modules	Teaching Hours
Module-I **INTRODUCTION**: Stages of design Codes and Standards in Design, Properties of engineering materials, Factor of safety, Stress – Strain relationship for ductile and brittle materials **DESIGN AGAINST STATIC LOAD:** Principal stresses, Modes of failure, Theories of failure, Calculate the magnitude of maximum tensile and compressive stresses at the extreme fibers in the machine elements subjected to static loading (For square, rectangle, circular cross sections only, hollow and solid sections)	**8 Hours**
Module-II **STRESS CONCENTRATION:** Causes for Stress concentration, Methods to mitigate the effect of stress concentration. Stress concentration factors, Notch sensitivity, Estimating the stress concentration at various stress raisers for different load conditions, Deciding the dimensions for safety and safe load carrying capacity. **DESIGN AGAINST FLUCTUATING LOAD:** Fluctuating stresses, Fatigue failure, Endurance limit, Design for finite and infinite life (for combination of maximum two types of loads), Soderberg's and Goodman criteria..	**8 Hours**
Module-III **MECHANICAL JOINTS:** Riveted joints advantages and disadvantages, Failure of riveted joints, Design of riveted joints for given arrangement of rivets and load conditions. Welded joints, Finding the depth of weld depending upon the array and load conditions, Screwed joints (For only Eccentric loading of above joints) **SHAFTS, KEYS AND COUPLINGS:** Design of shafts for the cases of simple loading, Design against static load, Strength and rigidity design, Types of keys, Design of square and flat keys, Design of Rigid and flexible couplings for given load and speed conditions.	**9 Hours**

Module-IV **BELTS:** Flat Belts, Ratio of belt tensions with and without centrifugal tension, Slip, Creep, Initial Belt tension, Design of belt drive for given speed, center distance and material of belt, V-Belts : Construction, Advantages and disadvantages, Ratio of belt tensions, Design of V-belt drive for given power and speed conditions. **POWER SCREWS:** Forms of threads, Square threads, Trapezoidal threads, Stresses in screw, Torque required to raise and lower the load, Efficiency, Self locking and overhauling conditions, Design of Screw jack to lift the given load through required height.	**9 Hours**
Module V **BRAKES:** Necessity for brakes, Design of Block Brakes, Simple and Differential Band Brakes, Band and Block Brakes for given operating conditions. **CLUTCHES:** Function of clutch, Uniform pressure and Uniform wear theories, Torque transmitted by the single plate clutch, Design of Single plate and Multi plate clutches, Design of Cone clutch. Calculation of Force required for engaging the clutch and finding the dimensions of the plates.	**8 Hours**

Question paper pattern:

1.Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.

2.Five full questions are to be answered selecting at least One full question from each Module.

3.Each question should not have more than 3 sub divisions.

Text books:

1. Design of Machine Elements By V B Bhandari, McGraw Hill
2. Machine Design By R S Khurmi, S. Chand Publications

Reference Books:

1. Mechanical Engineering Design By Shigley & Mische, McGraw Hill

2. Machine Design By Black & Adams, McGraw Hill

Course outcomes:

On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Use codes and standards for machine elements and to design the machine elements subjected to compound stresses.
CO2	Investigate stress concentration factor depending upon the type of stress raiser and loading and to design the elements subjected to fluctuating loads
CO3	Design mechanical joints and different types of couplings along with shaft and key as per the given
CO4	Design suitable belt drives and power screws to transmit power under given conditions.
CO5	Design suitable brakes and clutches for the given conditions

COMPUTER AIDED MACHINE DRAWING (CAMD)			
Subject Code	**22MEL54**	**Credits: 01**	**CIE: 50**
Number of Lecture Hours/Week	**2(Practical)**		**SEE: 50**
Total Number of Lecture Hours	**28**		**SEE Hours: 03**

PREREQUISITE: Student should have Knowledge of drawing Engineering Graphics

COURSE OBJECTIVES:

After studying this course, student will be able:

1. To understand the concept of different Sectional views of Solids.
2. To understand the concept of Fasteners and riveted joints.
3. To understand the concept of Couplings and joints.
4. To understand the concept of solid modeling by using any CAD tool.

Part- A **(Minor Exercises)**	**Teaching Hours**
Introduction to 3D software and basic 3D commands: Practice of 3D commands,3D Assembly commands , 3D views. **Sectional views of Solids:-** Full section, Half section, Types of Half Section, Local section, Conventional Representation of Materials (Minimum 4 Exercise). **Basic Concepts of Parametric Modeling of simple machine parts:** **Fasteners**: Hexagonal headed bolt and nut. **Riveted Joints**: Single Riveted joints and double riveted joints Lap joints. **Joints**: Knuckle joint for two rods and cotter joint. **Couplings** : Split muff coupling and protected type flanged coupling.	**10 Hours**
Part –B (Major Exercises) **Assembly Drawing s using Solid edge 3D package.** 1. Screw Jack. 2. Machine vice. 3. Plummer Block.	**18 Hours**

Question paper pattern:
Students have to Solve 3 Full questions

Q. No.1 Fasteners or Rivets--only sketching

Q. No.2 Joints or couplings --only sketching

Q. No.3 Assembly drawing using solid edge 3 D package----- Only Computer Work

Text books:

1. Drawing standards , IS-696 /SP46, BIS Publication, Kolkata, India
2. Machine Drawing, Fifth edition, K L Narayana , P Kannaiah, K Venkat reddy, New Age International Publications, New Delhi, India.
3. Machine Drawing, N D Bhatt, V M Panchal, Charotar publication, Anand , India

Reference Books:

1. CBT on Machine Drawing ,Sonaversity, salem, Tamilnadu , India
2. Machine Drawing, K R Gopalkrishan , Subhash Publications,Bangalore, India

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Recognize the importance of sectioning solids for understanding internal structures.
CO2	Explain the purpose of sketches in depicting Nut and Bolt as well as Riveted joints.
CO3	Construct manual sketches demonstrating the assembly of components in Cotter and Knuckle Joints.
CO4	Differentiate and illustrate various views necessary for understanding couplings assembly.
CO5	Develop 3D models of assembly components and generate multiple views using a 3D software package.

Elective -4

REFRIGERATION AND AIR-CONDITIONING		
Subject Code	16ME561	CIE: 50
Number of the Lecture Hours/ Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	S E Exam: 03 Hours

PREREQUISITE:

1. Refrigeration engineering courses are geared toward students who want to design and build refrigeratio9n as well as heating, ventilation and air conditioning (HVAC) systems.

1. The thermodynamic cycle and the concept of energy transfer concepts are essential, as they apply to refrigeration, are discussed in this course.

COURSE OBJECTIVES:

1. The concepts and analysis of air refrigeration system, Vapour compression refrigeration system.
2. The advanced Vapor compression system, also analyzes the multi loads and multi pressure systems.
3. The description and working of different equipments used in Vapor compression system. Also learns the concepts, types and analysis of Vapour absorption refrigeration system.
4. Psychometry-Definitions, Chart and different Psychrometric process used and study the different control equipments used in air conditioning system.
5. Design of air conditioning systems, cooling load calculations and transmission and distribution of air in the air conditioning system.

Modules	Teaching Hours
Module-I REFRIGERATION: Principles – Ideal cycle, Bell Coleman cycle, COP and its calculations. REFRIGERANTS: Selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, Comparative study of Ethane and Methane derivatives, Substitutes for CFC Refrigerants, ECO friendlily refrigerants.	7 hrs
Module-II REFRIGERATION SYSTEMS: Types of Refrigerations --- Vapors Compression System --- Thermodynamic analysis with P-H and T-S Diagrams, performance of System under varying operating conditions, cascade refrigeration, Multistage refrigeration working principles. Vapor Absorption System --- Ammonia – Water	8 hrs

Absorption System, Actual vapor Absorption cycle and its representation on Enthlpy – Composition diagram, calculations. Triple fluid vapor absorption refrigeration system, Water- Lithium bromide absorption chiller.	
Module-III AIR CONDITIONING: Psychrometry- psychrometer, psychometric processes, Terms used in air conditioning systems, Summer Air conditioning and Winter Air conditioning systems, reheat cycles by pass factor. DESIGN CONDITIONS: Effective Temperature- Comport conditions, Internal Heat gain, System heat gain, Break up of Ventilation Load and Effective sensible heat factor, cooling and heating load calculations, Methods of duct design air, Selection of Air Conditioning Apparatus for Cooling and Dehumidificaton, Evaporative Cooling.	9 hrs
Module-IV TRANSMISSION AND DISTRIBUTION OF AIR: Air Distribution System, Fans and Air Conditioning systems control. Room Air Distribution. Frection loss in ducts, Dynamic losses in Ducts, Airflow through simple Duet system.	9 hrs
Module-V BALANCING OF COMPONETNS: Condensers- Air cooled, water cooled and evaporative condensers, Selection, Evaporator – Flooded, Dry expansion, Compressors-Reciprocating, Rotary and Centrifugal types, Expansion Devices. CONTROLS IN REFRIGERATION AND AIR CONDITIONG EQUIPMENTS: High Pressure and Low Pressure cut out, Thermostats, Pilot Operated Solenoid Valve, Motor Controls, By pass Control – Damper Motor, VAV Controls	9 hrs
Question paper pattern: 1) Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus. 2) Five full questions are to be answered selecting at least One full question from each Module. 3) Each question should not have more than 3 sub divisions.	
Text books: 1) Refrigeration and Air-conditioning by C.P.Arorar, Tata MeGraw Hill Publication. II Edition, 2001. 2) Manohar Prasad Refrigeration and Air-conditioning Willey Estern limited, New Delhi 1983	

Reference Books:

1. Stocker Refrigeration and Air-conditioning Tata McGraw Hill Publishing Company limited New Delhi 1981.
2. Roy J Dossat "Principals of Refrigration S I Version Wiley Estern limited New Delhi 1985.
3. Refrigration and Air-conditioning by Jordon & Priester PHI Publications 1995.
4. Thermodynamics Data Hand book by Nijaguna & Samaga 2022.

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:

CO	Course Outcome (CO)	Blooms Level
CO1	Apply the knowledge of fundamentals of refrigeration systems	1.3
CO2	Identify and formulate the various refrigeration cycles by using natural and engineering sciences.	L1, L5
CO3	Designing the different conditions for refrigeration systems based on environmental considerations.	L6
CO4	Applying reasons obtained by contextual knowledge to asses health safety and legal issues relevant to professional engineering practices.	L3
CO5	Understand the impact of professional engineering solutions in environmental context and function effectively as an individual or leader in multidisciplinary	L2

OPERATIONS MANAGEMENT			
Subject Code	**22ME552**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

COURSE OBJECTIVES:

1.Apply the various methods of forecasting
2. Define capacity and utilization and their relationship to financial performance measures.
3. Define the key performance measures to consider the need for the schedule.
4. Design of Conversion process systems in manufacturing and service organizations.
5. Illustrate the role of operations, and their interaction with the other activities of a firm: finance, marketing, organization, corporate governance, etc.

Modules	Teaching Hours
Module-I **Introduction**: Role of operations in an organization, a process view, a supply chain view, operations strategy, competitive priorities and capabilities, addressing the trends and challenges in operations management, decision making models	8 hrs
Module-II **Process strategy and analysis:** process structure in services and manufacturing process, strategy decisions, strategic fit, strategies for change, documenting and evaluating the process, redesigning and managing process improvements	8 hrs
Module-III **Planning capacity:** Planning long term capacity, planning timing and sizing strategies, a systematic approach to long term capacity decisions, tools for capacity planning, waiting line models. **Managing process constraints:** the theory of constraints, managing bottlenecks in service and manufacturing processes, applying the theory of constraints to product mix decisions, managing constraints in line processes. .	9 hrs
Module-IV **Forecasting Demand:** managing demand, key decisions on making forecasts, forecast error, judgment methods and casual methods: linear regression, time series, forecasting as a process. **Managing Inventories:** inventory tradeoffs, types of inventory, inventory reduction tactics, ABC Analysis, economic order quantity, continuous review system, modeling review system, special inventory models.	9 hrs
Module V **Planning and Scheduling Operations:** levels in operations planning and scheduling, S&OP supply options, S&OP strategies, scheduling. **Efficient resource planning:** Material requirements planning, master production scheduling, MRP explosion, enterprise resource planning, resource planning for service providers.	8 hrs

Question paper pattern:

1.Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2.Five full questions are to be answered selecting at least One full question from each Module.
3.Each question should not have more than 4 sub divisions.

Text books:

1.Operations Management – Processes and Supply Chain,Lee J Karjewski and Larry P Ritzman, Manoj Malhotra, 11th Edition, 2010, Pearson Education Asia, ISBN: 0133872467, 9780133872460 2. Internal Combustion Engines, M. L. Mathur and R. P. Sharma, DhanpatRai Publications, 2014.

2. Production and Operations Management, R. Paneerselvam, 2nd Edition, 2006, PHI, ISBN:81-203-2767-5

Reference Books:

1. Operations Management – Theory and Practice, B. Mahadevan, 2nd Edition, 2010, PHI, ISBN: 978 8131730706
2. Productions & Operations Management, Adam & Ebert, 5th Edition, 2002, Prentice Hall, ISBN – 013718008-X.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Explain the concept and scope of operations management in a business context
	CO2	Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
	CO3	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making.
	CO4	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
	CO5	Evaluate a selection of frameworks used in the design and delivery of operations

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The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

Note: CIE FOR 03 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.

The question needs to be framed covering the entire syllabus (33%) completed before the consecutive IEs.

The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

MACHINE TOOL DESIGN			
Subject Code	**22ME553**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE: Basics knowledge of strength of materials and manufacturing processes.

COURSE OBJECTIVES:

1. To apply the knowledge of strength of materials and manufacturing processes in the machine tool design
2. To understand the intricacy of machine tool layout.
3. To have the knowledge of different drives in machine tools.
4. To study the design of structure of machine tool design.
5. To analyze the dynamic stability of machine tools

Modules	Teaching Hours
Module-I **PRINCIPLES OF MACHINE TOOL DESIGN:** General requirement of machine tool design- design process machine toll layout. **GENERAL REQUIREMENTS OF MACHINE TOOLS:** Center lathe, Milling machine.	7 hrs
Module-II **MACHINE TOOL DRIVES AND MECHANISMS:** Working and auxiliary motion. Drives- electric drives. Hydraulic transmission, Mechanical transmission. Kinematic structure. Regulation of speed and feeds. Stepped regulation, standardization of speed and feed, stepless regulation of speeds and feeds. Cutting force analysis and power requirement in turning, Milling, Drilling, shaping and broaching operation (with simple problems).	8 hrs
Module-III **DESIGN OF MACHINE TOOL STRUCTURES:** Functions- Requirements- Design criteria Material used- static and dynamic stiffness- Profile and basic design procedure for machine tool structure, Design of beds, columns, housing, bases, tables, cross- rails, arms, saddle, carriages.	6 hrs
Module-IV **DESIGN OF GUIDE WAYS AND POWER SCREWS:** Functions and types of guide ways- Design and lubrication of slide ways- Aerostatic slide ways- Antifriction slide ways, combination guide ways- Protecting devices, design of power screws. **DESIGN OF SPINDLE AND SPINDLE BEARINGS:** Functions- Requirements and materials for spindle compliance and machining accuracy, design of spindles- Antifriction bearings, hydrodynamics and hydrostatic bearing, Air lubricated bearing .	11 hrs
Module V **DYNAMICS OF MACHINE TOOLS:** Concept of dynamic cutting process, Physical causes of chatter and vibrations, Types of chatters, Stability charts, Chatter vibrations- Lathe- Drilling machine- Grinding machine, Milling machine, Different methods for avoiding machine tool chapter and vibrations. **CONTROL SYSTEM IN MACHINE TOOL:** Functions, Requirements, and classifications. Control system for speed and feeds centralize control pre-selective control, control system foe forming and auxiliary motions- Mechanical control- Ergonomics considerations and compatibility- Automatic control. System- Electrical Hydraulic- Pneumatic systems.	**10 hrs**

Question paper pattern:

1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2. Five full questions are to be answered selecting at least One full question from each Module.
3. Each question should not have more than 4 sub divisions.

Text books:

1. N K Metha, Machine Tool Design, TATA McGraw-Hill 2001.
2. N Acharkan, Machine Tool Design, Volume II and III MIR Publications, 2000.

Reference Books:

1. S K Basu and D K Pal, Design of Machine Tools, 2000
2. Sen and Bhattacharya, Principles of Machine Tools, Oxford I.B M Publications. 2000.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understand the general requirements of a machine tool.
	CO2	Able to apply the design principles in designing machine tool parts.
	CO3	Learn the different drives present in a machine tool
	CO4	Estimate the dynamic stability of machine tools subjected to chatter
	CO5	Understands different control systems in machine tools.

Note: CIE FOR 03 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.

  The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.

  The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

  Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

ROBOTICS AND ROBOT APPLICATIONS			
Subject Code	**22ME554**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE:

1. The development and use of robot is essential to the mechanical engineers with basic skills of kinematics and dynamics of the components along with transmission of power.
2. Fundamental knowledge of mathematics, matrix algebra.

COURSE OBJECTIVES:

1. To familiarize students with brief history of robot and basic concepts of industrial Robot.
2. To expose the students to kinematics of robots and programming of robot.
3. To make the students familiar with various applications in robots in industry

Modules	Teaching Hours
Module-I **Introduction:** Automation and robotics, brief history, social and economic aspects of robots, advantages and disadvantages of using robots in industries. Overview of robots-present and future applications. Industrial and biomedical applications of robots. **Classification and Structure of Robotic System:** Classifications geometrical configurations, wrist and its motions, end effectors and its types, links and joints. **Robot Drive Systems:** Hydraulic, electric and pneumatic drive systems, resolution, accuracy and repeatability, advantages and disadvantages of drive.	8 hrs
Module-II **Control Systems and Components:** Basic control system concepts and models, transformation and block diagram of spring mass system, controllers-ON and OFF, proportional integral, proportional and integral, transient and response to second order system. Robot actuation and Feedback component. Robot end effectors and grippers. Tooling, Robot safety collaborative.	8 hrs
Module-III **Robot Arm Kinematics:** Kinematics – Introduction, direct and inverse kinematics, rotation matrix,composite rotation matrix, rotation matrix about an arbitrary axis, Euler angles representation, homogeneous transformations, links, joint and their parameters, D-H representation. **Introduction Robot Arm Dynamics & Applications of Robots**: Lagrange – Euler formulations – Joint velocities, Kinetic energy, potential energy and motion equations of a robot manipulator. Industrial & Biomedical applications of Robots.	10 hrs
Module-IV **Trajectory Planning:** Introduction, general considerations on trajectory planning, joint interpolated trajectories, 4-3-4 trajectory example. Planning of Cartesian path trajectories. **Robot Programming:** Introduction, manual teaching, lead through teaching, programming languages – AML and –VAL – [simple examples], Programming with graphics, storing and operating, Task programs.	8 hrs

Module V	
Sensors: Internal state sensors, tactile sensors, - proximity sensing, range sensing, and force – torque sensors, Elements of computer vision. Sensing and digitizing function in machine vision – image devices – lighting techniques – analog to digital signal conversion – sampling – quantization – encoding – image storage. Image processing and analysis, Feature Extraction and object recognition.	8 hrs

Question paper pattern:

1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2. Five full questions are to be answered selecting at least One full question from each Module.
3. Each question should not have more than 3 sub divisions.

Text books:

1. Industrial Robotics – Groover. Mc Graw Hill 2003
2. Robotics – K.S.Fu, R.C, Gonzales and Lee, Mc Graw Hill International 1987.

Reference Books:

1. Robot manipulators, Mathematics, Programming and Control- Richard Paul.2000
2. Robotics – Yorem Coren, Mc Graw Hill Intl, Book Co., New Delhi2001
3. Fundamentals of Robotics – Robert J Schilling 2003
4. Robotic Engg, - Richard D. Klafter, PHI.2003
5. Robotics and Control by R.K. Mittal and J Nagarath, Tata Mc Graw Hil, 1995

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Will have the knowledge of fundamentals of robotics, graphics, and configurations of serial manipulators, workspace, frames, 3D transformations
CO2	Describe the concepts of Euler's angles, Differential velocities, D-H Representation, Forward and Inverse kinematics, fuzzy logic and robot vision.
CO3	Application of Calculus & Linear algebra, for kinematics, dynamics & trajector planning respectively.
CO4	Analysis of serial manipulators using Lagragian and Newton-Euler formulation, 3D transformations and D-H parameters.
CO5	Development of generic algorithms to perform various robot tasks and obtain the robot program.

Note: CIE FOR 03 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a

maximum of three bits.
The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.

The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

MINI PROJECT			
Subject Code	22MEMP56	**Credits: 02**	CIE: 50
Number of Lecture Hours/Week	04 (Practical)		
Total Number of Lecture Hours	28		

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS			
Subject Code	22RMI57	**Credits: 03**	CIE: 50
Number of Lecture Hours/Week	2:2:0		SEE: 50
Total Number of Lecture Hours	28		SEE Hours: 03

Prerequisite : Nil

Course Objectives:

1: To Understand the knowledge on basics of research and its types.
2: To Learn the concept of defining research problem and Literature Review,Technical Reading.
3: To learn the concept of attributions and citation and research design.
4: Concepts, classification, need for protection, International regime of IPRs - WIPO , TRIPS, Patent - Meaning, Types, surrender, revocation, restoration, Infringement , Procedure for obtaining Patent and Patent Agents.
5: Meaning, essential requirements, procedure for registration and Infringement of Industrial Designs, Copyright.

Modules	Teaching Hours
Module –I Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.	**06 Hours**
Module –II **Defining the research problem** - Selecting the problem. Necessity of defining the problem Techniques involved in defining the problem- Importance of literature review in defining a problem. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.	**06 Hours**
Module –III **Research design and methods** - Research design - Basic principles. Need of research design Features of good design- Important concepts relating to research design - Observation and Facts. **Attributions and Citations:** Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	**06 Hours**

Module –IV Basic Concepts of Intellectual Property (IP), Classification of IP, Need for Protection of IP, International regime of IPRs - WIPO , TRIPS. **Patents:** Meaning of a Patent – Characteristics/ Features . Patentable and Non-Patentable Invention. Procedure for obtaining Patent. Surrender of Patent, revocation &restoration of Patents, Infringement of Patents and related remedies (penalties) . Different prescribed forms used in Patent Act. Patent agents qualifications and disqualifications Case studies on patents - Case study of Neem patent, Curcuma(Turmeric)patent and Basmati rice patent, Apple inc.v Samsung electronics co.Ltd.	**05 Hours**
Module –V **Industrial Design**: Introduction to Industrial Designs. Essential requirements of Registration. Designs which are not registrable, who is entitled to seek Registration, Procedure for Registration of Designs. **Copy Right** Meaning of Copy Right. Characteristics of Copyright. Who is Author, various rights of owner of Copyright. Procedure for registration. Term of copyright, Infringement of Copyright and Its remedies. Software Copyright.	**05 Hours**

Text books:

1. Research Methodology: Methods and Techniques C.R.Kothari, Gaurav Garg New Age International 4thEdition,2018
2. Dipankar Deb•RajeebDey,ValentinaE.Balas "EngineeringResearchMethodology",ISSN1868- 4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.3.
3. Dr. M.K. Bhandari"Law relating to Intellectual property" January 2017 (Publisher By Central Law Publications).
4. Dr. R Radha Krishna and Dr. S Balasubramanain "Text book of Intellectual Property Right". First edition, New Delhi 2008. Excel books.
5. P Narayan "Text book of Intellectual Property Right". 2017 ,Publisher: Eastern Law House.

Reference Books:

1. DavidV.Thiel"ResearchMethodsforEngineers"CambridgeUniversityPress,978-1-107-03488- 4-
2. Nishith Desai Associates - Intellectual property law in India – Legal, Regulatory & Tax

NPTEL:
INTELLECTUAL PROPERTY by PROF.FEROZ ALI , Department of Humanities and Social Sciences IIT Madras https://nptel.ac.in/content/syllabus_pdf/109106137.pdf
www.wipo.int
www.ipindia.nic.in

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

CO	Course Outcomes
CO1	To know them leaning of engineering research.
CO2	To know the defining of research problem and procedure of Literature Review.
CO3	To know the Attributions and Citations and research design.
CO4	Highlights the basic Concepts and types of IPRs and Patents
CO5	Analyse and verify the procedure for Registration of Industrial Designs & Copyrights.

Assessment Details (both CIE and SEE)

The weight age of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE(Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
Three Unit Tests each of 20 Marks (duration 01hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester Group discussion/ Seminar/quiz any one of three suitably planned to attain the Cos and Pos for 20 Marks (duration 01 hours)
6. At the end of the 13th week of the semester.

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50marks** (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the Outcome defined for the course.

ENVIRONMENTAL STUDIES			
Subject Code	22ES58	**Credits: 02**	CIE: 50
Number of Lecture Hours/Week	2:0:0		SEE: 50
Total Number of Lecture Hours	28		SEE Hours: 03

Prerequisite : Nil

Course Objectives:

To create environmental awareness among the students.ν

To gain knowledge on different types of pollution in the environment.ν

Teaching-Learning Process(General Instructions) These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos and animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Environmental awareness program on off campus
3. Encourage collaborative (Group Learning) Learning in the class.Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills

Modules	**Teaching Hours**
Module –I Environment-Definition, components, Ecosystem-Balanced Ecosystem, Structural and functional unit of Ecosystem, Human activities – Economic and Social Security	**05 Hours**
Module –II Human activities Effects on Environment-Industries, Housing, Agriculture, mining, Transportation, Natural Resources-Water Resources, forest, mineral resources, fluoride problems in Drinking water, water Induced diseases. Deforestation, sustainable mining,	**06 Hours**
Module –III Material cycles – Nitrogen, Sulphur, carbon cycle Environmental pollution –ground water pollution, noise pollution, soil pollution, Industrial and Municipal sludge. Air pollution, B.O medical waste E-wastes, Automobile pollution	**06 Hours**
Module –IV Global Environmental Concerns-Climate change and global warming effects, urbanization, ozone layer depletion, acid rain, current Environmental issues and important, population growth, Environmental toxicology, Biogas energy, solar energy.	**06 Hours**
Module –V Objects of Environmental studies, Importance of women's Education, non-government organization (NGO), Green building or water treatment plant, G.I.S and Remote sensing, EIA (Environmental Impact Assessment), Role of Government for protection of Environmental	**05 Hours**

Reference Books:

1. Environmental Studies- Benny Joseph –Tata Megrawhill 2005
2. Environmental Studies-D L Manjunath, P M Dotrad, B.S.Raman
3. Environmental Studies-Geeta Naagbhushan

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

CO	Course Outcomes
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
CO5	Understand Latest Developments in Environmental Pollution Mitigation Tools Concept and Applications of G.I.S. & Remote Sensing.

Continuous Internal Evaluation:

Three Unit Tests each of **20Marks (duration 01 hour)**
1. First test at the end of5th week of the semester
2. Second test a the end of the10th week of the semester
3. Third test at the end of the15thweek of the semester Two assignments each of **10 Marks**
4. First assignment at the endof4thweek of the semester
5. Second assignment at the end of 9thweek of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the Cos and Pos for **20 Marks (duration 01hours)**
6. At the end of the13thweek of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be Scaled down to 50 marks

(to have less tresses CIE, the portion of the syllabus should not be common/repeated for any of the method of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods/question paper is designed to attain the different levels of Bloom' s taxonomy as per the outcome defined for the course.

Semester End Examination:
Theory SEE will be conducted by college as per the scheduled timetable, with common question papers for the subject (duration 01 hours) Question paper pattern:
1. The Question paper will have 50 objective questions.
2. Each question will before 01marks
3. Students will have to answer all the questions on an OMR Sheet.
4. The Duration of the Exam will be 01 hour.

Non Credit Mandatory Course (NCMC)			
Subject Code	22NS59/22PH59/22YO59	**Credits: 00**	CIE: 50
Number of Lecture Hours/Week	2(Practical)		
Total Number of Lecture Hours			

B.E VI Sem

HEAT AND MASS TRANSFER			
Subject Code	**22ME61**	**Credits: 04**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory) +2(Practical)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE: :

1. Knowledge of heat interactions learnt in thermal engineering subjects prior to study of heat and mass transfer.
2. Knowledge of basic differentiation and integration.

COURSE OBJECTIVES:

1. To familiarize the student regarding heat and mass transfer phenomenon occurring in various systems
2. Apply the principles to real processes, so as to achieve maximum performance

Modules	Teaching Hours
Module-I **STEADY STATE HEAT CONDUCTION:** Introduction regarding modes of heat transfer. General heat conduction equation in Cartesian co-ordinates. Boundary and initial conditions. Temperature distribution and heat flow through Slab, hollow cylinder and hollow sphere with uniform thermal conductivity. Electrical Analogy for solving conduction heat transfer problems. Heat flow through composite slabs, composite cylinders and composite spheres. Concept of overall heat transfer coefficient Critical. Thickness of insulation for cylinder and sphere.	11 hrs
Module-II **UNSTEADY STATE HEAT CONDUCTION:** Lumped system analysis. Time constant and response of temperature measuring instruments. Transient heat conduction in solids with finite conduction and convective resistances. Transient conduction with given temperature distribution. **EXTENDED SURFACES:** Temperature distribution and heat flow through a rectangular fin-general expression, when the end of the fin is insulated and Fin is infinite.	11 hrs
Module-III **NATURAL CONVECTION:** Dimensionless empirical relation for heat transfer coefficient using Buckingham pi theorem. Physical significance of dimensionless numbers used in natural convection. Empirical Correlations for free convection-plates and cylinders. **FORCED CONVECTION:** Physical mechanism. Physical significance of dimensionless numbers used in forced convection.	10 hrs
Module-IV **THERMAL RADIATION:** Basic theories of radiation heat transfer. Reflectivity, Absorptivity, Transmissivity. Concept of black body, Planck's law of radiation, Wien's displacement law, total emissive power, Stefan-Boltzman law, Concept of Grey body, emissivity, Kirchoff's law of radiation. **HEAT EXCHANGERS:** Introduction, Types of heat exchangers, heat exchanger analysis, Logarithmic temperature difference for parallel and counter flow, Temperature distribution and heat flow in condenser and evaporator, Overall heat transfer coefficient, heat exchanger effectiveness by NTU method for parallel and counter flow.	10 hrs

Module V **BOILING AND CONDENSATION:** Boiling heat transfer-General aspects, boiling regimes, factors affecting nucleate boiling, Condensation: Drop wise and film wise condensation, Laminar film condensation on a vertical plate. **MASS TRANSFER:** Introduction, modes of mass transfer, concentrations, velocitiesand fluxes, Fick's law, General mass diffusion equation in stationary media, steadystate diffusion through- a plain membrane and a cylindrical shell.	10 hrs

Question paper pattern:

1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2. Five full questions are to be answered selecting at least One full question from each Module.
3. Each question should not have more than 4 sub divisions.

Text books:

1 Heat and Mass Transfer by Domkundwar, Dhanpat Rai Publications, 2012
2 Heat and Mass Transfer by R K Rajput, Laxmi Publications, 2012

Reference Books:

1 Heat Transfer by J P Holman, Tata Mc Graw Hill Co-Ltd, New Delhi
2 Heat Transfer by M N Ozisik, Tata Mc Graw Hill Co-Ltd, New Delhi
3 Heat Transfer by Yunus A Cengel, Tata Mc Graw Hill Co-Ltd, New Delhi
4 Heat and Mass Transfer by B N Veeranna, Sudha Publications, Bangalore.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understanding the principles and application of conduction mode of heat transfer to steady state.
	CO2	Understanding the principles & application of conduction mode of heat transfer to unsteady state.
	CO3	Ability to deal with the principles and application of forced and free convection mode of heat transfer.
	CO4	Ability to deal with the principles and application of thermal radiation mode of heat transfer, temperature Distribution and heat flow in heat exchangers.
	CO5	Understanding the principles & application of boiling, condensation heat transfer and Mass Transfer.

HEAT TRANFER LAB

PREREQUISITE: 1. Knowledge of heat interactions learnt in thermal engineering subjects prior to study of heat and mass transfer.
2. Knowledge of basic differentiation and integration.

COURSE OBJECTIVES:

1. To introduce to the student, the various modes of heat energy transfer with a pre-requisite knowledge of fluid mechanics and thermodynamics.
2. To understand the heat exchange in different types of heat exchangers.

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Modules	Teaching Hours
Determination of thermal conductivity of insulating materials using lagged pipe apparatus. Determination of thermal conductivity of materials using Composite wall apparatus.	6 hrs
Determination of heat transfer coefficient using Natural convection apparatus. Determination of heat transfer coefficient using Forced convection apparatus	7 hrs
Determination of emissivity of surfaces using Emissivity apparatus.	2 hrs
Determination of effectiveness of parallel flow heat exchanger. Determination of effectiveness of counter flow heat exchanger	7 hrs
Determination of Stefan Boltzman constant. Determination of condensation heat transfer coefficient.	6 hrs

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Determine experimentally the laws of conduction heat transfer using lagged pipe apparatus, composite wall apparatus
CO2	Determine experimentally the laws of convection heat transfer using natural convection apparatus.
CO3	Determine experimentally the laws of radiation heat transfer using emissivity apparatus, stefan-boltzman apparatus.
CO4	Determine experimentally the effectiveness of parallel and counter flow heat exchanger using heat exchanger set up.
CO5	Determine experimentally the laws of convection heat transfer using forced convection apparatus

I) CIE AND SEE FOR THE INTEGRATED PROFESSIONAL CORE COURSE (IPCC) WITH 4 CREDITS (L-T-P: 3-0-2)

A) CIE THEORY COMPONENT

The CIE theory component constitutes of

- CIE - Internal Assessment Test with maximum 15 marks with minimum passing 6 marks
- CIE - Continuous and Comprehensive Assessment with maximum 10 marks with minimum passing 4 marks

There shall be three Continuous Internal Evaluations (CIE)

- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.
- The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.
- The cumulative marks of the three CIE is to be divided by 6 to reduce the final CIE marks to a maximum of 15 marks and the minimum passing mark for this is 6.

DESIGN OF MACHINE ELEMENTS-II			
Subject Code	**22ME62**	**Credits: 04**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory) +2(Tutorial)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE:

1)Mathematical methods such as Differentiation, Integration, Linear differential equations, Geometry of plane surfaces,

2) Mechanics of materials: Stress, strain, Elastic constants, Types of loads and stresses, center of gravity & moment of inertia,

3) Design of machine Elements-I: Factor of safety, Properties of engineering materials, Design for Static and fatigue loading.

COURSE OBJECTIVES:

1. To introduce to Winkler Bach equation and apply it for the computation of tensile and compressive stresses for the given static load conditions on curved beams & and principles for the design of mechanical systems involving springs.
2. To be able to understand the terminologies used for gears and design the spur gears and helical gears from static load, dynamic load and wear considerations.
3. To be able to design suitable sliding contact bearings and rolling contact bearings for the given operating conditions.
4. To design bevel gears, worm & worm gears considering the specified operating conditions.
5. To be able to design suitable I.C.Engine parts such as Piston, Connecting rod, valve mechanism for the given service conditions.

Modules	Teaching Hours
Module-I **Design of Curved Beams:** Winkler Bach equation, Stresses in curved beams of standard and simple cross sections used in crane hooks, Punching presses, Clamps (such as isosceles triangle, square, rectangle, circle and rhombus, Solid and hollow). **Springs:** Types of springs, terminology – Stresses in Helical coil springs of circular sections, Energy stored in springs. Concentric springs, springs under fluctuating loads.	8 hrs
Module-II **Design of Spur Gears**: Terminology, Lewis beam equation, Tooth form factor, design of Spur gears from strength consideration in Bending, Wear and Dynamic loading, Gear materials and suggesting suitable hardness. **Design of Helical Gears:** Tooth relationship, tooth proportions, Formative teeth number, Design of simple Helical Gears and double Helical Gears from strength, dynamic load and wear considerations. Suggesting suitable hardness.	8 hrs

Module-III **Lubrication and Sliding Contact Bearing:** Types of lubrication, Viscosity, Hydrodynamic theory of Lubrication, Types of Bearings, Dimensionless numbers, Design of Bearings using Design Charts, Boundary lubrication, Hydrostatic bearing, Hydrodynamic bearings, Thrust bearings. **Anti-Friction Bearings:** Types of ball bearings, Roller bearings, Needle bearings, life of Bearings in hours and millions of revolutions, Reliability considerations, Selection of ball bearings, roller bearings for the specified operating conditions and given axial load, thrust load and fluctuating loads. .	10 hrs
Module-IV **Worm Gears**: Types of Worm gearing, Analysis of forces, Power rating, Efficiency, Worm gear standards and proportions, Artificial cooling, Design of worm and worm wheel for given transmission ratio and other operating conditions. **Bevel Gears:** Straight bevel gears, Types of bevel gears, Back cone, Formative teeth number, Design of bevel gears for Bending, wear and Dynamic loading.	8 hrs
Module V **Design of I.C.Engine Piston and Connecting Rod:** Different parts of an I.C.Engine, Function of each part, material used, Design of piston for the given operating condition, Selection of suitable I – section for main body of connecting rod, Design of connecting rod for the given operating conditions. **Design of Valve Gear Mechanism: V**alve mechanism for the given operating conditions.	8 hrs

Text books:

1. Design of Machine Elements By V B Bhandari, McGraw Hill

2. Machine Design By R S Khurmi, S. Chand Publications

Reference Books:

1. Mechanical Engineering Design By Shigley & Mische, McGraw Hill

2. Machine Design By Black & Adams, McGraw Hill

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Design curved beams standard cross sections spring for given operating conditions.
	CO2	Design Spur gear and helical gear considering strength, wear and dynamic loading.
	CO3	Design worm gear and bevel gear as per the given requirements and conditions.
	CO4	Design Sliding contact bearings and Rolling contact bearings as per the given conditions.
	CO5	Design I.C.Engine parts such as piston. connecting rod, and valve gear mechanism

Note: CIE FOR 04 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.

  The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.

  The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

  Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

Professional Elective-II

OPERATIONS RESEARCH			
Subject Code	**22ME631**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE: Fundamentals of Mathematics, Statistics and Probability.

COURSE OBJECTIVES:

1. Fundamentals of OR, formulation of linear programming problems. Graphical solution, Simplex method, Big M method.
2. Various types of transportation and assignment problems
3. Network analysis (PERT/CPM).
4. Sequencing machine problems and Queuing model.

Modules	Teaching Hours
Module-I **INTRODUCTION TO OR:** Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods. **LINEAR PROGRAMMING PROBLEMS:** Basic Solutions, Feasible Solutions, Optimal Solutions, Degenerate Solutions, Simplex methods. Big-M method in LPP.	**9 Hours**
Module-II **TRANSPORTATION PROBLEM:** Formulation of Transportation Model, Basic Feasible Solution by NWC Rule, Lowest cost entry and Vogel approximation methods. Unbalanced problem, Optimality Method, (MODI method for optimality check) degeneracy in transportation. **ASSIGNMENT PROBLEM:** Formulation, Hungarian Method, Unbalanced Problem, Assignment for Maximization, Traveling Salesman Problem.	**9 Hours**
Module-III **CPM- TECHNIQUES:** Network Construction, determination of critical path and Total Elapsed time, Concept of slack and Float. **PERT TECHNIQUES:** Network Construction, Estimation of Project duration and Variance, analysis about the completion of projects. Crashing of simple network.	**9 Hours**
Module-IV **SEQUENCING:** Terminology & Notations, Principle assumptions, Solution of sequencing problem: Processing of n - jobs through 2 machines, n jobs through 3 machines, Processing 2 jobs through m machines, processing n jobs through m machines. **GAME THEORY:** Formulation of Games, Characteristics of games, Two-Person Zero Sum game, Maximin/ Minimax principle, Saddle point, games without saddle point, Solution for (2 x 2) game, dominance property, Graphical solution for (2 x n) and (n x 2) game.	**9 Hours**

Module V	
REPLACEMENT PROBLEM: Basic Concept of Replacement of items that deteriorate with time: costs involved Replacement procedure with and without consideration of Time value of money. Replacement of items that Fail suddenly: Group Replacement. **QUEUEING THEORY:** Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models –M/M/1 problems.	**8 Hours**

Question paper pattern:

Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
Five full questions are to be answered selecting at least One full question from each Module.
Each question should not have more than 3 sub divisions.

Text books:

1. Taha S A –"Opeartions Research and Introduction", McMillian
2. S.D.Sharma –"Opeartions Research", Kedarnath, Ramnath and Co.

Reference Books:

1. Hiller and Liberman-" Introduction to Operations Research", McGraw Hill V Edn
2. Philips, Ravindran and Soeberg- "Principles of Operations research", PHI

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Recognize the importance and value of Operations Research and formulate research models to solve real life problems for allocating limited resources by linear programming.
CO2	Apply transportation and assignment models to real life situations.
CO3	Apply project management techniques like CPM and PERT to plan and execute project successfully.
CO4	Apply sequencing and Games theory concepts in industry applications.
CO5	Apply the mathematical tool for decision making regarding replacement of items in real life and apply queuing theory for performance evaluation of engineering and management systems.

Note: CIE FOR 03 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.

The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.

The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.

Students have to answer 5 full questions, selecting one full question from each module.

The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.

There will be 2 questions from each module. Each of the two questions under a module

AUTOMATIC CONTROL ENGINEERING			
Subject Code	**22ME632**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours: 03**

PREREQUISITE:

1)Mathematical methods such as Differentiation, Integration, Linear differential equations, Laplace Transformation, Matrices & Determinants etc.

2) Physics : Newton's laws of motion, Translational & Rotational systems, Fundamentals of Hydraulics & Pneumatics.

COURSE OBJECTIVES:

1) To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different mechanical systems for analysis.

2) To be able to represent and then reduce block diagram and Signal flow Graph of a control system to find the overall transfer function.

3) To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system.

4) Formulate different types of analysis in frequency domain to explain the nature of stability of the system and to ascertain the same using Routh's Stability Criterion.

Modules	**Teaching Hours**
Module-I **<u>INTRODUCTION</u>**: Concepts of control Systems, Requirements of good control system Open Loop and closed loop control systems and their differences, Different examples of control systems used in domestic, industrial and military applications, Classification of control systems, Feed-Back Characteristics, Effects of feedback. **<u>MATHEMATICAL MODELLING:</u>** Differential equations, Transfer function of Translational and Rotational mechanical systems**,** Hydraulic and pneumatic systems.(Only I and II order systems)	8 hrs

Module-II **BLOCK DIAGRAM ALGEBRA:** Block diagram representation of systems, Basic rules for block diagram reduction, Reduction of multi loop block diagrams into canonical form to find overall transfer function, Problems solving on block diagram reduction (For SISO systems only). **SIGNAL FLOW GRAPHS:** Definition of important terms, Representation of differential equations by Signal flow graph, Construction of equivalent Signal flow graph for the given block diagrams, Mason's gain formula and its application to the Signal flow graphs to find the overall transfer function	8 hrs
Module-III **TIME RESPONSE ANALYSIS:** Standard test signals, Time response of first order systems, Characteristic Equation of Feed-back control systems, Transient response of second systems, Time domain specifications, Steady state errors and constants. **ROUTH- HURWITZ STABILITY CRITERION:** Condition on roots of characteristic equation for stability, Necessary and sufficient conditions, Special cases, Absolute and conditional stability, Finding gain and frequency of oscillations for marginal stability. Concept of Relative stability. .	8 hrs
Module-IV **STABILITY ANALYSIS IN FREQUENCY DOMAIN:** Introduction, Frequency domain specifications, Polar plots, Nyquist plots and applications of Nyquist stability criterion to find the stability, adjustment of gain to obtain required specifications, Effects of adding poles and zeroes. **BODE PLOTS:** Determination of frequency domain specifications and transfer function from the Bode Diagram, Phase margin and gain margin, Stability analysis using Bode plots.	10 hrs
Module V **CLASSICAL CONTROL DESIGN TECHNIQUES:** Basic controller actions, Advantages and disadvantages, PID controllers, Compensation, Necessity, Types, characteristics of Lag, Lead and Lag – Lead compensation. **STATE-SPACE APPROACH TO CONTROL SYSTEMS:** Modern Control Theory, Definitions, State Transition Matrix, Properties of State Transition Matrix, Controllability and Observability.	8 hrs
Question paper pattern: 1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus. 2. Five full questions are to be answered selecting at least One full question from each Module.	
Text books: 1. Modern Control Engineering By Nagrath and Gopal, Mc Graw Hill Publications	

Reference Books:

1. Modern Control Engineering By K. Ogata, Mc Graw Hill Publications

Course outcomes:

On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form and to Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.
CO2	Construct / Reduce multi loop block diagrams and Signal flow graphs to simple forms and hence to determine the overall transfer function of the system.
CO3	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and to ascertain the stability using Routh's stability criterion.
CO4	Formulate different types of analysis in frequency domain to explain the nature of stability of the system.
CO5	Identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system and to evaluate State transition matrix, Controllability & Observability of simple control systems using State-space techniques.

FINITE ELEMENT METHODS				
Subject Code	22ME633	Credits	03	CIE: 50
Number of Lecture Hours/Week	3 (Theory)			SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03
Prerequisite: Should have knowledge of physics, mechanics, strength of materials, linear algebra, mechanical properties of materials.				
Course Objectives: The course aims to provide an introductory approach to finite element method as a basic numerical tool for solving mechanical engineering problems.				
Modules				**Teaching Hours**
MODULE-I **INTRODUCTION TO FEM:** Need, Advantages and disadvantages of FEM, Engineering Applications, Steps involved in FEM, Discretization process – types of elements (1D,2D,3D), size of the elements, location of nodes, node numbering scheme, Method of solution of linear algebraic equations – Gauss elimination method. Numerical integration by Gaussian quadrature (one point and two point formula). Basic elastic equations – body force and traction force, strain-displacement relations. Principle of minimum potential energy and derivation of potential energy functional for a 3D elastic body, concept of plane stress and plane strain and their stress-strain relations.				10 Hours
MODULE-II **INTERPOLATION MODELS:** Displacement function, selection of the order of displacement function, convergence criteria, geometric isotropy, Pascal's triangle for 2D polynomial, Different co-ordinate systems used in FEM, Interpolation or shape functions for 1D linear and quadratic bar elements and 2D linear triangular (CST) element in cartesian and natural co-ordinate systems. Lagrangian polynomial – Shape functions for linear quadrilateral element (QUAD 4) and quadratic quadrilateral element (9-noded), Iso-parametric, subparametric and super-parametric elements, Concept of Jacobian matrix, Jacobian matrix for CST.				08 Hours
MODULE-III **ELEMENT STIFFNESS MATRIX AND LOAD VECTORS:** Strain displacement matrix, Stiffness matrix and load vector for linear and quadratic bar element and CST element. Assembly of elements by direct stiffness method, special characteristics of stiffness matrix, Treatment of boundary conditions- elimination and penalty methods. Analysis of axially loaded uniformly tapered and stepped bars.				08 Hours
MODULE-IV **ANALYSIS OF PLANE TRUSSES AND BEAMS:** Local and global coordinate systems, stiffness matrix for plane truss element, analysis of truss members. Hermite shape function for beam element in Cartesian coordinates, Stiffness matrix and load vector for beam element, element shear force and bending moment, analysis of beams.				08 Hours
MODULE-V **ANALYSIS OF HEAT TRANSFER PROBLEMS:** Steady state heat transfer, 1D heat conduction- governing equation, boundary conditions, one-dimensional element, Galerkin's approach to heat conduction, heat flux boundary condition. 1D heat transfer in thin finsFormulation of equations. Simple numerical of 1D heat transfer problems on composite walls and fins with conduction and convection.				08Hours
Question paper pattern: 1. Total of Ten Questions with two from each MODULE to be set covering the entire syllabus.				

2. Five full questions are to be answered choosing at least one from each MODULE.
3. Each question should not have more than 4 sub divisions.

Text books:

1 Chandrakanth S Desai and J.F. Abel, "Introduction to the Finite Element Method," CBS, 1st edition, 2005, ISBN: 978-8123908953.
2 T R Chandrupatla and A D Belegundu, "Introduction to Finite Elements in engineering," Pearson, 4th edition, 19th October 2011, ISBN: 978-0132162746.
3 Singiresu S Rao, "The Finite Element Method in engineering," Elsevier Publisher, 5th edition, 2008 ISBN: 978-9380931555.

Reference Books:

1 O.C.Zienkiewicz, "The FEM its basics and fundamentals," Elsevier Publisher, 6th edition, 2007, ISBN: 978-8131211182.
2 J.N.Reddy, "Finite Element Method," McGraw Hill International Edition, 2005, ISBN: 9780072466850.
3 Daryl. L. Logon, "Finite Element Methods," Thomson Learning 5th edition, 1st Jan 2011, ISBN: 978-0495668251.
4 David V. Hutton, "Fundamentals of Finite Element Analysis," Tata McGraw Hill Publishing Co. Ltd, New Delhi, 10th June 2005, ISBN: 978-0070601222.

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understand the basic concepts and mathematical preliminaries of FEM required to solve basic field problems.
	CO2	Develop interpolation models for 1D and 2D elements that satisfy convergence criteria and geometric isotropy and use isoparametric concept in the finite element analysis.
	CO3	Formulate element stiffness matrices and load vectors for different elements using variational principle and analyze axially loaded bars.
	CO4	Use finite element formulations in the determination of stresses, strains and reactions of trusses and transversely loaded beams.
	CO5	Formulate finite element equations for heat transfer problems using Variational and Galerkin techniques and apply these models to analyze conduction and convection heat transfer problems.

ALTERNATE FUELS				
Subject Code	22ME634	Credits	03	CIE: 50
Number of Lecture Hours/Week	3 (Theory)			SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03
Prerequisite: Basic concept of Engineering Chemistry, Thermodynamics and Fluid mechanics.				
Course Objectives: 1. To explain the importance of alternate fuels, their availability, properties and to delineate the types of them. 2. To analyze and apply the effects of use of alcohols on Performance and Emission in SI and CI engines. 3. To modify SI and CI engines which use CNG, LPG, H2, Biogas as fuels, to analyze Performance and Emission Characteristics of them. 4. To test the Performance and Emission parameters of Vegetable oils and Bio-diesels on CI engines. 5. To examine different energy sources available for hybrid engines and to explain with sketches ECS, Fuel cell and Batteries.				
Modules				**Teaching Hours**
MODULE-I **Introduction:** Need for alternate fuel, availability and properties of alternate fuels, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar energy.				**08 Hours**
MODULE-II **Alcohols:** DME, DEE and their blends and their effects on performance of SI and CI engines and Combustion and Emission characteristics related numerical problems.				**08 Hours**
MODULE-III **Natural Gas, LPG, Hydrogen and Biogas:** modification required in engines, Performance and Emission Characteristics of CNG, LPG in SI and CI engines, Hydrogen as fuel, its storage, handling, performance and safety.				**10 Hours**
MODULE-IV **Vegetable Oils:** Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, biodiesel and its characteristics.				**08 Hours**
MODULE-V **New Generation Energy Sources (NGES):** Energy sources for hybrid engines, advantages and limitations, required system components and Electronic Control Systems (ECS), for use of NGES in engines, High energy and power density batteries, fuel cell.				**08 Hours**
Question paper pattern: 1. Total of Ten Questions with two from each MODULE to be set covering the entire syllabus. 2. Five full questions are to be answered choosing at least one from each MODULE. 3. Each question should not have more than 4 sub divisions.				

Text books:

1. Alternative Fuels Guide Book, Richard L. Bechfold, SAE International Warren dale - 1997
2. Energy Today & Tomorrow, Maheswar Dayal, I & B Horsier India - 1982.

Reference Books:

1. Power Plant Engineering, Nagpal, Khanna Publishers - 1991.
2. Alcohols as motor fuels progress in technology, Series No.19, SAE Publication USE - 1980.

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Explain the importance of alternate fuels, their availability, properties and to delineate the types of them.
CO2	Analyze and apply the effects of use of alcohols on Performance and Emission in SI and CI engines.
CO3	Modify SI and CI engines which use CNG, LPG, H2, Biogas as fuels, to analyze Performance and Emission Characteristics of them.
CO4	Evaluate the Performance and Emission parameters of Vegetable oils and Bio-diesels on CI engines.
CO5	Examine different energy sources available for hybrid engines and to explain with sketches ECS, Fuel cell and Batteries.

Open Elective – I

INDUSTRIAL ENGINEERING AND ERGONOMICS			
Subject Code	**21MEOE641**	**Credits: 03**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**		**SEE: 50**
Total Number of Lecture Hours	**42**		**SEE Hours**

PREREQUISITE: Basic knowledge of Industrial engineering and management.

COURSE OBJECTIVES:

1. The main objective of this course is to provide students with skills in systematic analysis of work methods, work measurement and work design to improve productivity.
2. Understand the concepts of productivity and use of scientific methods.
3. Learn to create graphical tools like process charts and diagrams to analyze and improve an operation.
4. Understand the use of motion analysis and the principles of motion Economy to design/re-design a workplace.
5. Learn to compute standard times for operations from direct time studies, fundamentals of standard data systems, predetermined time standards and work sampling.

Module-I **PRODUCTIVITY AND WORK STUDY:** Definition of Productivity, individual enterprises, task of management. Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting productivity, measures to improve productivity. **WORK STUDY:** Definition, advantages and procedure of Work study, objective and scope of work-study. Human factors in work study. Work study and management, worker, and supervisor. Job Evaluation: Basic concepts, Objectives.	9 hrs
Module-II **METHOD STUDY** : Definition, objective, procedure scope of method study, types of recording techniques and their applications, therbligs, principles of motion economy, classification of movements, micro-motion study. Development, definition and installation of the improved method.	8 hrs
Module-III **WORK MEASUREMENTS:** Definition, objectives and benefit of work measurement, work measurement techniques. **STOP WATCH TIME STUDY**- definition, time study equipment, selection of job, steps in time study, breaking the job into elements, recording information, Rating, scales of rating, factors affecting rate of working, standard performance, allowances and standard time determination.	8 hrs
Module-IV **ERGONOMICS:** Definition and importance, areas of study under ergonomics, system approach to ergonomics model system, work capabilities of industrial worker, Measuring Work by Physiological means. Work Posture, Anthropometry- Need, Important Body Dimensions, Data Collection, Statistical Analysis, Percentile.	8 hrs

Module V	
DESIGN OF MAN-MACHINE SYSTEMS: man-machine system. Components of man-machine and their functions, Fatigue in industrial workers, Fatigue Measurement and Evaluation, Quantitative and qualitative representation, alphanumeric displays, controls and their design criteria, control types, relation between controls and displays. **DESIGN OF WORKPLACE:** Human performance under, heat, and cold, illumination, vibration, noise pollution.	9 hrs

Question paper pattern:

1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.
2. Five full questions are to be answered selecting at least One full question from each Module.
3. Each question should not have more than 4 sub divisions.

Text books:

1. O.P Khanna, Dhanpat Rai & sons, Industrial Engineering and Management.
2. Bhanga and Sharma, Industrial Engineering and Ergonomics.

Reference Books:

1. ILO, Introduction to Work study
2. M. S. Sanders and Ernest J. McCormick, McGraw Hill Inc., Human Factors Engineering and Design
3. Barnes Ralph, Motion and Time Study – Design and Measurement of Work Wiley 4. Suresh Dalela - Work Study and ergonomics,

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	The student should be able to understand the importance of productivity
CO2	The student should be able to use various charts and diagrams to analyze and develop improved methods of working
CO3	The student should be able to determine the time standards.
CO4	The student should understand the importance of human factors and ergonomics in productivity improvement.
CO5	Knowledge to plan and design the ergonomically according to the requirement of the comfort to the engineer to work satisfactorily.

Note: CIE FOR 03 CREDIT PROFESSIONAL CORE COURSE

The CIE theory component constitutes of

- CIE IA Test with maximum 25 marks and minimum passing 10 marks
- CIE CCAs with maximum 25 marks and minimum passing 10 marks
- There shall be three Continuous Internal Evaluations (CIE) for the courses with 03 credits.
- The CIE Question paper shall be set for a maximum of 30 marks with questions having a maximum of three bits.

The question needs to be framed covering the entire syllabus (33%) completed before the consecutive CIEs.

The cumulative marks of the three CIE is to be divided by 3.6 to reduce the final CIE marks to a maximum of 25 marks and the minimum passing mark for this is 10.

Another 25 marks are dedicated to other assessment tools with suitable weightage for each, that include quizzes, assignments, mini-projects, presentations, case studies, surveys, group discussions, slip tests, etc, and the minimum passing mark for this is 10 (If the assessment is mini-project based then only one assessment method may be adopted or otherwise, any two assessment tools may be used.

SEMESTER END EXAMINATION (SEE):

Theory SEE will be conducted by scheduled timetable, with question papers for the subject (duration 03 hours).

The question paper shall be set for 100 marks.

- The duration of SEE is 03 hours. The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module.
- The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module

MAJOR PROJECT PHASE_I			
Subject Code	22MEMP65	**Credits: 02**	CIE: 50
Number of Lecture Hours/Week	04 (Practical)		
Total Number of Lecture Hours			

MANUFACTURING PROCESSES -II LAB			
Subject Code	22MEL66	**Credits: 01**	CIE: 50
Number of Lecture Hours/Week	02 (Practical)		SEE:50
Total Number of Lecture Hours	28		**SEE Hours: 03**

Course Objectives:

1. To gain hands on experience of foundry practice and moulding sand testing.
2. To understand different forming methods and prepare a forging model.
3. To provide insight into different machine tools and their operations and prepare model.

PART-I

Foundry and Forging : Demonstration of moulding procedure . Testing of moulding sand: compression, Shear and tensile tests, permeability test, Clay content test, Moisture content test, Mould hardness test.

PART-II

Machine tools : Lathe : turning, facing, taper turning, chamfering, knurling – 1 model
Shaper: Key way cutting - 1 model.
Milling: Gear cutting - 1 model
Grinding: Surface grinding – 1 model.

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

CO	Course Outcomes
CO1	Describe the importance of primary manufacturing processes.
CO2	Recognize of sizing and shaping of metallic materials by chip less machining processes, defects in manufactured components and their remedies.
CO3	Apply the Skill to fabricate simple parts and test them.
CO4	Create and practically understand the moulding procedure and different moulding processes.
CO5	Analyze the melting practice and to perform various sand testings and also recognize the importance of fusion welding and special welding techniques .

INDIAN KNOWLEDGE SYSTEMS
(Theory)
(Common to All UG Programs)

Course Code	**:**	**22IKSAE67**		**CIE**	**:**	**50Marks**
Credits :L:T:P	**:**	**1:0:0**		**SEE**	**:**	**50Marks**
Total Hours	**:**	**15L**		**SEE Duration**	**:**	**02Hours**

Course Learning Objectives : The students will be able to

1. TofacilitatethestudentswiththeconceptsofIndiantraditionalknowledgeandtomake them understand the Importance of roots of knowledge system.
2. Tomakethestudentsunderstandthetraditionalknowledgeandanalyzeitandapplyit to their day-to-day life.

Module-I **Introduction to Indian Knowledge Systems(IKS):**Overview, Vedic Corpus, philosophy, Character scope and importance, traditional knowledge vis-à-vis indigenous knowledge, Traditional knowledge vs. Western knowledge.	**05 Hrs**
Module–II **Traditional Knowledge in Humanities and Sciences:** Linguistics, Number and Measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.	**05 Hrs**
Module-III **Traditional Knowledge in Professional domain:** Town planning and architecture-construction, Health, wellness and Psychology- Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.	**05Hrs**

Course Outcomes :
After completing the course, the students will be able to

CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2:	Appreciate the need and importance of protecting traditional knowledge.
CO3:	Recognize there levance of Traditional knowledge indifferent domains.
CO4:	EstablishthesignificanceofIndianKnowledgesystemsinthecontemporaryworld.

Reference Books

1. **IntroductiontoIndianKnowledgeSystem-conceptsandapplications**,BMahadevan, VinayakRajatBhat,NagendraPavanaRN,2022,PHILearningPrivateLtd,ISBN-978-93-
2. 91818-21-0
3. **TraditionalKnowledgeSysteminIndia**,AmitJha,2009,AtlanticPublishersandDistributors
4. (P)Ltd.,ISBN-13:978-8126912230,
5. **Knowledge Traditions and Practices of India**, Kapil Kapoor, AvadeshKumarSingh,Vol.1,
6. 2005,DKPrintWorld(P)Ltd.,ISBN81-246-0334,
7. **Suggested Web Links:**
8. **https://www.youtube.com/watch?v=LZP1StpYEPM**
9. **http://nptel.ac.in/courses/121106003/**
10. http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63(Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
11. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
12. https://unctad.org/system/files/official-document/ditcted10_en.pdf
13. http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
14. https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%(CIE)**	**50%(SEE)**
QUIZZES		
Quiz-I Quiz-II	Each quiz is evaluated for 05 marks adding upto**10 Marks.**	*****
THEORY COURSE-(Bloom's Taxonomy Levels: Remembering, understanding, Applying, Analyzing, Evaluating, and Creating)		
Test–I Test–II	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced To **20 Marks**	*****
EXPERIENTIAL LEARNING	**20**	*****
Case Study-based Teaching-Learning	--	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	--	
Video based seminar(4-5minutes per student)	--	
Maximum Marks for the Theory	--	**50 Marks**
Practical	--	
Total Marks for the Course	**50**	50

Non Credit Mandatory Course (NCMC)			
Subject Code	22NS68/22PH68/22YO68	**Credits: 00**	CIE: 50
Number of Lecture Hours/Week	2(Practical)		
Total Number of Lecture Hours			