BIRLA VISHVAKARMA MAHAVIDYALAYA

(ENGINEERING COLLEGE)

(AN AUTONOMOUS INSTITUTION)

VALLABH VIDYANAGAR – 388120, GUJARAT

AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY

ACADEMIC REGULATIONS

AND

COURSES OF STUDY

FOR

FOUR YEAR DEGREE PROGRAMME LEADING TO

BACHELOR OF TECHNOLOGY (B.TECH.)

IN

PRODUCTION ENGINEERING

Implemented from the batch admitted in academic year 2018-19

Institute Vision 3

Programme Vision 4

PROGRAM OUTCOMES (POs) 5

Academic Regulations (Major) – UG.18 6

ANNEXURE – I: Programme of studies leading to the degree of the Bachelor of Technology (Production Engineering) 15

ANNEXURE –II: Syllabi for the courses offered in programme of studies leading to the degree of Bachelor of Technology (Production Engineering) 21

Institute Vision

"Produce globally employable innovative engineers with core values."

Institute Mission

- Re-engineer curricula to meet global employment requirement
- Promote innovative practices at all levels.
- Imbibe core values
- Reform policies, systems and processes at all levels.
- Develop faculty and staff members to meet the challenges

Core Values

Quality, Creativity, Team Work, Lifelong Learning, Pro-activeness, Cost Consciousness, Sharing, Transparency

B.Tech. Production programme offered by Department of Production Engineering

Programme Vision

To develop competitive engineers having strong fundamentals in the production engineering and possess competency to innovate and develop newer products

Programme Mission

- Modify production engineering curriculum to meet the present and future employment requirements.
- Promote innovative practices at all levels in the production engineering program.
- Imbibe high moral values (Integrity, Loyalty, and Sincerity & Perseverance).
- Reform policies, systems, processes at all levels in production engineering program.
- Upgrade knowledge, skill & competency of faculty members & students to meet the recent trends & challenges.

Program Educational Objectives (PEO's):

1. Optimize production & maintenance activities to produce components/machine tool/machine/equipments using the manufacturing processes.
2. Develop and implement various productivity and quality improvement strategies.
3. Adopt state-of-the-art developments in production engineering & promote interdisciplinary studies.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex production engineering problems.
2. Identify, formulate, review research literature, and analyse complex production engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for production engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health & safety, cultural and societal & environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. Apply appropriate techniques, resources, modern engineering and IT tools including prediction and modelling to production engineering activities with an understanding of their limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health & safety, legal & cultural issues and the consequent responsibilities relevant to the professional production engineering practice.
7. Understand the impact of the professional production engineering solutions in societal and environmental contexts, demonstrate the knowledge of the same and need for sustainable development.
8. Apply ethical principles& commit to professional ethics and responsibilities & norms of the production engineering practice.
9. Function effectiveness an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communicate effectively on production engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of the production engineering and management principles and apply those to one's own work, as a member and leader in a team, to manage production engineering projects in multidisciplinary environments
12. Recognize the need for, have the preparation and ability to engage in independent and life-long learning in the broadest context of production engineering technological changes.

PSOs:

1. Analyze the manufacturing processes, tooling material and the machine tools for quality and safe manufacturing of the industrial products using conventional and computer aided techniques.
2. Manage the maintenance related activities of machine tools/machines/equipment's /industrial products in an industry.
3. Innovate the products through productivity improvement methods, manufacturing utilities and recent advances in the production engineering.
4. Design cost effective, energy efficient, ecofriendly machine elements, products, automation systems considering the societal contexts and following ethical actions.

Academic Regulations (Major) – UG.18

FOR **UNDER GRADUATE** PROGRAMMES (FULL TIME)

UG.18.1 ADMISSION

UG.18.1.1 A candidate seeking admission to the four year degree programme for Bachelor of Technology must have eligibility as per the Gujarat Government/ Admission Committee for Professional Courses (ACPC) / Gujarat Technological University (GTU)/ Charutar Vidya Mandal (CVM) rules.

UG.18.1.2 Admission granted to an applicant is to be considered provisional until all the fees are paid and all the prescribed documents are in order. BVM Engineering College DISCLAIMS ALL RESPONSIBILITIES**,** if any, of the documents required as per ACPC/ GTU norms, which are not submitted or found unacceptable by it. The institute will not accept any responsibility for students who do not submit the expected examination / registration / enrollment forms in time.

UG.18.2 PROGRAMMES OF STUDY

UG.18.2.1 A student shall undergo the prescribed courses as given in the programme of studies to obtain his/her degree in major in which he/she is admitted. These courses for various programmes are listed in Annexure – I.

UG.18.2.2 A student shall undergo the courses as prescribed by the respective Board of Studies from time to time to obtain minor engineering degree in the respective programme(s). For awarding minor degree, regulations are annexed here as Annexure – III.

UG.18.3 COURSE LEVELS

UG.18.3.1 At the commencement of each semester a student shall register for the set of courses offered during the semester. For the registration process, refer UG.18.9.

UG.18.3.2 All courses offered are divided into four levels: Level 1 to Level 4. The levels correspond to successive years of study of a typical B. Tech. student, i.e. a regular student will complete his/her Level-1 courses during his/her first year, Level-2 courses during his/her second year, and so on.

UG.18.4 COURSE CATEGORIES

Courses taken by a student to complete his/her degree programme are divided into Humanities and Social Science, Basic Science, Engineering Science, Mandatory Courses, Professional Core Courses, Programme Elective Courses, Open Elective Courses, Project Work, Seminar and Internship.

UG.18.4.1 COMPULSORY COURSES

Each programme of studies contains a certain number of compulsory courses, they are categorized as Programme core courses, seminar and project work / dissertation.

UG.18.4.2 **PROGRAMME ELECTIVE COURSES**

Each programme of studies contains a certain number of programme elective courses. Programme elective courses will be offered under each discipline at corresponding level from which a student may choose course(s).

UG.18.4.3 **OPEN ELECTIVE COURSES**

Open elective courses are courses offered by a discipline for students other than the corresponding discipline.

UG.18.4.4 **MANDATORY NON CREDIT COURSES**

Each programme of studies contains a certain number of mandatory non-credit courses decided by respective Board of Studies.

UG.18.5 DEFINATION OF STATUS OF COURSE

UG.18.5.1 **REGULAR COURSES**

Each programme of studies contains a certain number of courses (including elective courses and mandatory non-credit courses) to be studied in respective semester decided by respective Board of Studies.

UG.18.5.2 **BACKLOG COURSES**

The courses in which student has not obtained letter grade DD or above / PP at first attempt (Refer UG.18.13).

UG.18.6 PRE-REQUISITES

UG.18.6.1 A student shall not be allowed to enroll for any course at Level-4 unless he/she has completed all his/her course requirements at Level-1 with acceptable grades (Refer UG.18.13).

UG.18.7 COURSE CREDITS

UG.18.7.1 Each course offered has **L-T-P** structure, where "**L"** means number of theory lecture hours per week, **T** means number of tutorial hours per week and "**P"** means number of practical hours per week.

UG.18.7.2 Total course credits for a course are obtained by adding credits of theory lectures, tutorials and practical together. e.g. 1 hr. Lecture = 1 credit, 1 hr. Tutorial = 1 credit & 1 hr. Practical = 0.5 credit.

UG.18.8 FACULTY COUNSELOR

UG.18.8.1 Each student is assigned to a Faculty Counselor who will advise and counsel him/her regarding the selection of courses to be registered in a given semester as well as monitor his/ her holistic growth.

UG.18.8.2 Each student must obtain approval for "Backlog" courses (Refer UG.18.5.2) from the Faculty Counselor.

UG.18.9 REGISTRATION

UG.18.9.1 To earn course credits in a semester a student must register for the courses at the commencement of the semester.

UG.18.9.2 At the commencement of each semester the **first working day** is designated as the Registration Day. A student must complete his/her registration formalities on that day as per the procedure laid down by the institute.

UG.18.9.3 A further period of 12 working days is designated as late registration period. During this period a student shall require to pay late registration fees, as decided by the institute from time to time to complete his/her registration. Late registration will only be permitted on genuine reasons, (Refer UG.18.12.3) subject to the approval of the Principal.

UG.18.9.4 Student shall not be permitted to attend classes without registration.

UG.18.9.5 The registration must be completed by the student in person.

UG.18.9.6 A student who has completed all the requirements for his/her B. Tech. degree (Refer UG.18.19) will not be allowed to register in any further courses.

UG.18.9.7 All registrations in every semester must be duly approved by the Principal.

UG.18.9.8 Student should obtain approval from Faculty Counsellor to register any Backlog course(s) within 10 days of declaration of results of the previous semester or first 10 days of the commencement of semester, whichever is later.

UG.18.9.9 Total number of credits for Backlog courses should not be more than 24.

UG.18.10 WITHDRAWAL

UG.18.10.1 Student may withdraw all the courses registered in a semester before four weeks of commencement of End Semester examination. Further, on genuine reasons (Refer UG.18.12.3) a student can withdraw at any time during the entire semester. In such cases NO FEES will be refunded.

UG.18.11 ASSESSMENT OF STUDENT PERFORMANCE IN A COURSE

UG.18.11.1 The performance of a student in a course will be evaluated based on (i) continuous assessment of theory and tutorial/practical work and (ii) end-semester theory and tutorial / practical examinations.

UG.18.11.2 The end- semester theory examination in a course has a weightage of 60 % of total theory marks. Out of the remaining 40 % of theory marks, 30 % of marks will be evaluated based on mid semester examination and remaining 10 % based on continuous assessment carried out during the semester as declared by the course coordinator in first week of beginning of the semester.

UG.18.11.3 The end-semester tutorial/practical examination in a course has a weightage of 40 percent of total tutorial/practical marks and continuous assessment of the same carries the remaining 60 % of total tutorial/practical marks. Tutorial/practical work (both end-semester and continuous) shall be evaluated on the basis of the following instruments of assessment: observation of experimental skills, reports, oral examination, quizzes, end-semester practical examination and attendance.

Continuous assessment (tutorial/practical) scheme is given below:

Term work	30 % (Equal weightage for every practical. At least 10 practical/tutorial need to be performed or mini project)
Quiz/Assignment/ Viva/ active learning component	30 %
Total	**60 %**

The respective Board of Studies shall decide the list of the courses in which end semester practical evaluation is feasible. In such courses evaluation shall be based on practical as well as viva for 40 % marks of end semester tutorial/practical. If practical performance is not feasible then 40 % of marks as end semester tutorial/practical evaluation will be based only on viva**.**

UG.18.11.4 The overall performance of a student in a course is assessed on the principle of "single head of passing", i.e., there will be a single grade for a course based upon the aggregate of marks obtained by the student in theory and tutorial/practical components in continuous assessment as well as end semester examination. However, a student must score minimum 35% marks in end semester theory and tutorial/practical examination to make himself/ herself gradable.

UG.18.12 EXAMINATIONS

UG.18.12.1 The end-semester examination for all courses offered in an academic year will be conducted by the institute for awarding 60 % of marks out of the total theory marks.

UG.18.12.2 No student shall be allowed to appear in the end semester examination unless he/she has attended 100% of theory and tutorial/practical classes of each course and will be awarded letter grade FA (Refer UG.18.13) in all the courses he/she has registered in the corresponding semester, except backlog courses.

However, a maximum 25 % relaxation in attendance is permissible with prior intimation, along with required documents, from concerned authorities. The relaxation includes medical, co-curricular and extra-curricular activities, genuine social engagements etc.

UG.18.12.3 The institute will conduct two continuous assessment of theory (mid semester examination) in a semester for each course for the evaluation of 30 % of total theory marks. The average marks of two mid semester examinations shall be considered as the final marks for mid semester examination.

A student who remains absent in any of the two mid semester examination for whatsoever reason(s) shall be awarded with zero marks in the respective mid semester examination.

However, if a student remains absent due to any of the following genuine reasons, for such students a special examination may be conducted by the department and marks obtained in the special examination will be considered as marks of the mid semester examination in which he/she has remained absent. Such student should obtain prior approval from the Principal.

a) A student is critically ill or injured and certified by Civil Surgeon.
b) Death of direct blood relation relative.
c) A student representing Gujarat state in national level events and/or India in International events organized by official boards.

UG.18.12.4 The institute will conduct only one continuous assessment of theory (mid semester examination) for all courses of the semester in the following cases.

a) First Semester of B. Tech. programme.
b) Third semester of B. Tech. programme for the students who are admitted in the second year of B. Tech. Diploma to Degree students.
c) Corresponding semester of the year of transfer for transferred students or international students, if the admission of such students is five weeks later than commencement of academic calendar.

UG.18.12.5 No student shall be allowed to appear in the end semester examination of a course unless he/she has scored at least 35% marks in mid semester examination and will be considered in "NOT PERMITTED TO APPEAR (NPTA)" status for the respective course and letter grade "NA" will be awarded (Refer UG.18.13).

The NPTA student(s) shall appear in mid semester remedial examination of the next semester.

UG.18.12.6 The End Semester tutorial/practical examination shall be rearranged for a student who is not able to appear in the regular schedule due to genuine reason(s) (Refer UG.18.12.3). Such student should obtain prior approval from the Principal.

However, such rearrangement should be confined within the Academic Calendar of the respective semester.

UG.18.13 LETTER GRADES

UG.18.13.1 The overall performance of a student in credit courses is represented by a letter grade from AA to FP, FA, NA and WD with the following meaning and equivalent grade points:

LETTER GRADE	EQUIVALENT GRADE POINTS	REMARK
AA	10	Outstanding
AB	9	Excellent
BB	8	Very Good
BC	7	Good
CC	6	Average
CD	5	Satisfactory
DD	4	Pass
FP	0	Failure due to Performance
FA	0	Failure due to Attendance
NA	0	Not Permitted To Appear
WD	0	Withdrawal

For non-credit courses the evaluation will be PASS or FAIL and for that the letter grade will be awarded PP or FP, respectively.

UG.18.13.2 A credit course is said to be completed successfully, only if a letter grade DD or better (in grade points) is obtained in that course.

UG.18.13.3 A non-credit course is said to be completed successfully only if a letter grade PP is obtained in that course.

UG.18.13.4 The scheme of awarding letter grades and the letter grades awarded in each course are subjected to scrutiny and approval by the Academic Council.

UG.18.14 FAILURE IN A COURSE

UG.18.14.1 A student earns **zero** credit for a course when he/she gets letter grade FP, NA, FA or WD in that credit course.

UG.18.14.2 If letter grade FA is obtained in an elective course, the student may change the elective.

UG.18.14.3 A student with letter grade FA/WD in courses should re-register the courses subsequently whenever offered.

UG.18.14.4 A student with letter grade FP should appear, at the earliest, in the end semester theory as well as practical/ viva exam and should obtain a letter grade DD or better (in grade points) in credit courses and PP in non-credit courses.

UG.18.14.5 A student having more than six Backlog courses (Refer UG.18.6.2) will not be allowed to move to the next level.

UG.18.15 SEMESTER PERFORMANCE INDEX (SPI)

UG.18.15.1 The performance of a student in a semester is expressed in terms of the semester Performance Index (SPI).

UG.18.15.2 The semester Performance Index is the weighted average of course grade points obtained by the student in the regular courses (Refer UG.18.6.1) registered in the semester. The weights assigned to course grade points are the credits carried by the respective courses.

That is,

$$SPI = \frac{\sum_{i=1}^{n} g_i c_i}{\sum_{i=1}^{n} c_i}$$

where, g_i is the equivalent grade point of i^{th} course,
c_i is the credit of the course
n is total number of regular courses registered by the student in a semester

UG.18.16 **CUMULATIVE PERFORMANCE INDEX (CPI)**

UG.18.16.1 The cumulative performance of student is expressed in terms of the Cumulative Performance Index (CPI). This index is defined as the weighted average of course grade points obtained by the student for all courses taken since his/her entry to the programme. The weights are defined in same way as in UG.18.15.2.

UG.18.16.2 If a student repeats a course, only the grade points obtained in the latest attempt is counted towards the Cumulative Performance Index (CPI).

UG.18.17 ADMISSION BY TRANSFER

UG.18.17.1 Any student aspiring for admission by transfer in any B.Tech. programme is not eligible for the same after 5th Semester of the respective B.Tech. programme.

UG.18.17.2 For a student admitted by transfer to any B.Tech. programme after completing part of his/her degree requirements elsewhere or under the previous academic regulations of BVM, he/she will be allowed to continue in subsequent level after completing all the requirements of previous levels of the respective institute or previous academic regulation. He/She will be exempted from all courses upto the completed levels. For these courses "EXEMPTED" status will be shown in the Transcript.

UG.18.17.3 The remaining requirements must be completed by the student as per UG.18.18.

UG.18.17.4 The CPI of such a student will be calculated only on the basis of the courses taken after transfer.

UG.18.18 REQUIREMENTS FOR THE AWARD OF B. Tech. DEGREE

UG.18.18.1 To be eligible for the award of the degree of Bachelor of Technology a student must earn total credits as prescribed by respective Board of Studies.

UG.18.18.2 The total credits requirements for the degree of B. Tech. must be completed in not more than 16 semesters from the date of admission. However, for a student admitted by transfer or Diploma to Degree (D2D) the maximum permissible duration shall be 100 % more than the period prescribed for completion of the programme at the time of admission.

UG.18.19 AWARD OF CLASS

UG.18.19.1 The class awarded to a student with his B. Tech. degree is decided by his final CPI as per the following table:

FIRST CLASS WITH DISTINCTION	- CPI not less than 7.10
FIRST CLASS	- CPI less than 7.10 but not less than 6.50
SECOND CLASS	- CPI less than 6.50 but not less than 5.50
PASS CLASS	- CPI less than 5.50

A candidate who passes in all courses and all heads of passing in the examination shall be given a gracing of the required CPI for getting second class/first class/first class with distinction, subject to a maximum of CPI 0.10, in concurrence with rules and guidelines of AICTE/ GTU.

UG.18.20 TRANSCRIPT

UG.18.20.1 The Transcript will be issued to the student as and when required and will contain a consolidated record of all the courses undergone by him/her, grades obtained and CPI upto the date of issue of transcript.

UG.18.20.2 Only last letter grade obtained in a course by the student upto the date of issue of transcript will be shown in the Transcript.

UG.18.21 EXAMINERS

UG.18.21.1 The respective board of studies shall appoint at least two examiners for end semester theory as well as practical/viva examination. For each end semester theory examination, there shall be two paper setters. One paper setter out of the two shall be from outside the institute (external examiner). The end semester practical examination of each subject shall be conducted by an internal (Examiner from the institute) and an external examiner. For 4^{th} level courses, each end semester theory examination evaluation shall be made by an internal and an external examiner. One of the internal examiner/s shall be appointed as convener who shall co-ordinate the examination procedure for end semester examinations of the respective subject.

UG.18.21.2 In the end semester practical examination maximum upto 60 students can be examined per day per examiner for first, second and third level courses and upto 45 students can be examined per day per examiner for fourth level courses.

UG.18.21.3 In the end semester practical examinations of Projects maximum upto 12 groups can be examined per day per examiner.

In the end semester practical examinations of Seminars maximum upto 20 groups can be examined per day per examiner

UG.18.22 REVIEW OF ESE THEORY ANSWER BOOKS

UG.18.22.1 A student shall apply for review of end semester theory answer book(s) within 7 working days after declaration of semester results. The student will have to pay the fees for the same as decided from time to time.

The answer book(s) of the student(s) who has applied for the review will be shown to him/her.

If student is satisfied with the assessment then he/she shall sign the answer book with a remark "Seen and Satisfied".

If student is not satisfied with the assessment, then the respective Board of Studies shall appoint two examiners (Convener of original exam and a new examiner) for the review of the end semester examination (theory) both sections. Both examiners shall jointly review both the sections and marks awarded in the previous assessment shall be kept open.

The marks obtained by the candidate after the review shall be considered for grading, only if, the change in mark is more than or equal to 10% of total mark of End Semester (Theory) Examination.

If change in grade is found after review, the review fees shall be refunded.

UG.18.23 GRADING

UG.18.23.1 The office of Controller of Examinations shall prepare the histogram of each course for the purpose of grading after the completion of assessment of the course.

UG.18.23.2 The convener of the respective course shall grade the students based on the histogram provided by the Controller of Examinations.

UG.18.24 GRADE REVIEW

UG.18.24.1 The Academic Council shall appoint a Grade Review Committee for each semester. The Grade Review Committee shall comprise of following members:

(a) Principal
(b) All Board of Studies Chairman
(c) University Nominee
(d) Dean, Academics
(e) Associate Dean, Academics
(f) Controller of the Examinations
(g) Joint Controller of Examinations
(h) Member Secretary, Academic Council
(i) Officer-in-Charge of Credit System

UG.18.24.2 The Grade Review Committee shall meet immediately after results of all courses are completed and review the grades awarded by the convener of respective course. The revision of the grade suggested by the Grade Review committee shall be considered as final grade and binding.

UG.18.24.3 The Grade Review Committee can grace upto 10 % of total marks of theory examination in marks of end semester theory exam to make a student gradable. However grace marks shall not be counted in the aggregate marks obtained by the student for the grade.

ANNEXURE – I: Programme of studies leading to the degree of the Bachelor of Technology (Production Engineering)

Semester 1

Sr. No.	Course Code & Course Title	L	T	P	H	C
1	**BS111[:] ADVANCED CALCULUS**	3	1	0	4	4
2	**BS103: PHYSICS**	3	0	2	5	4
3	**ES102: ELECTRONICS WORKSHOP**	0	0	2	2	1
4	**ES103: BASIC ELECTRICAL ENGINEERING**	3	0	2	5	4
5	**ES113: WORKSHOP PRACTICES – I**	0	0	4	4	2
6	**HS112: ENVIRONMENTAL SCIENCE**	2	0	0	2	0
	Total	**11**	**1**	**10**	**22**	**15**

*For Students admitted in AY 2018-19, **BS101: ADVANCED CALCULUS** (LTP:3,2,0)

$For Students admitted in AY 2018-19,

HS102: ENVIRONMENTAL SCIENCE (LTP:2,2,0)

Semester 2

Sr. No.	Course Code & Course Title	L	T	P	H	C
1	**BS112[:] LINEAR ALGEBRA AND FOURIER SERIES**	3	1	0	4	4
2	**ES106: PROGRAMMING FOR ENGINEERS**	1	0	4	5	3
3	**ES109: ENGINEERING GRAPHICS AND DESIGN**	2	0	4	6	4
4	**ES110: BASIC MECHANICAL ENGINEERING**	3	0	2	5	4
5	**ES114: WORKSHOP PRACTICES – II**	0	0	2	2	1

6	**HS101: ENGLISH**	2	0	2	4	3
	Total	**11**	**1**	**14**	**26**	**19**

[#] For Students admitted in AY 2018-19, **BS102: LINEAR ALGEBRA AND FOURIER SERIES**(LTP:3,2,0)

Semester 3

Sr. No.	Course Code & Course Title	L	T	P	H	C
1	2BS02: DIFFERENTIAL EQUATIONS AND STATISTICS	3	1	0	4	4
2	2PE01: MATERIAL SCIENCE AND PHYSICAL METALLURGY	3	0	2	5	4
3	2ES03: MECHANICS OF SOLIDS	3	0	2	5	4
4	2HS02: ECONOMICS AND MANAGEMENT	3	0	0	3	3
5	2PE02: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER	3	1	0	4	4
6	2PE03: DIMENSIONAL METROLOGY	2	0	4	6	4
	Total	**17**	**2**	**8**	**27**	**23**

Semester 4

Sr. No.	Course Code & Course Title	L	T	P	H	C
1	2PE04: MACHINING PROCESSES	3	0	2	5	4
2	2PE05: KINEMATICS AND DYNAMICS OF MACHINES	3	0	2	5	4
3	2BS05: NUMERICAL METHODS IN MANUFACTURING	3	0	2	5	4
4	2PE06: FLUID MECHANICS	3	0	2	5	4
5	2PE07: CASTING TECHNOLOGY	2	0	2	4	3
6	2HS01: PROFESSIONAL SOFT SKILLS	1	0	2	3	2
	Total	**15**	**0**	**12**	**27**	**21**

	PEIT1: Summer Internship - I (Three Weeks)#	-	-	-	-	0

#Non-Credit Mandatory course

Semester 5

Sr. No.	Course Code	Name of Course	L	T	P	H	C
1	3PE01	Design of Machine Elements	3	0	2	5	4
2	3PE02	Welding Technology	2	0	2	4	3
3	3PE03	Computer Aided Design	3	0	2	5	4
4	3PE04	Metal Forming Processes	3	0	2	5	4
5		Open Elective - I	3	0	0	3	3
6		Program Elective -I	3	0	2	5	4
		Total	**17**	**0**	**10**	**27**	**22**

Open Elective - I

1.	3CE81	Environment And Health	3	0	0	3	3
2.	3CE83	Earth System and Geo-environment	3	0	0	3	3
3.	3SE81	Disaster Management and Mitigation	3	0	0	3	3
4.	3CP81	Fundamentals of Computer Networks and Security	3	0	0	3	3
5.	3CP82	Fundamentals of Operating Systems	3	0	0	3	3
6.	3IT81	Cyber security	3	0	0	3	3
7.	3IT82	Internet Technology	3	0	0	3	3
8.	3IT83	Software Project Management	3	0	0	3	3
9.	3IT84	Enterprise Resource Planning	3	0	0	3	3
10.	3EE81	Energy Audit & Conservation	3	0	0	3	3
11.	3EE83	Installation and Commissioning of Electrical Equipments	3	0	0	3	3
12.	3EL81	Electronic Communication System	3	0	0	3	3
13.	3EC81	Introduction to Cellular Communication	3	0	0	3	3
14.	3EC82	Applied Electronics	3	0	0	3	3

Program Elective - I

1	3PE41	Reliability, Maintenance & Safety Engineering	3	0	2	5	4
2	3PE42	Project Management	3	0	2	5	4
3	3PE43	Mechatronics	3	0	2	5	4

Semester 6

Sr. No.	Course Code	Name of Course	L	T	P	H	C
1	3PE05	Computer Aided Manufacturing	3	0	2	5	4
2	3PE06	Tool Engineering	3	0	2	5	4
3	3HS01	Ethics & Constitution of India#	2	0	0	2	0
4		Open Elective – II	3	0	2	5	4
5		Programme Elective - II	3	0	2	5	4
6		Programme Elective - III	3	0	2	5	4
		Total	**17**	**0**	**10**	**27**	**20**
	PEIS2	Summer Internship-II (Three Weeks)#	-	-	-	-	0
		#Non-Credit Mandatory course					

Open Elective - II

1.	3CE82	Geo-Informatics	3	0	2	5	4
2.	3SE82	Advanced Strength of Materials	3	0	2	5	4
3.	3SE83	Basic Concepts of Structural Behaviour	3	0	2	5	4
4.	3CP85	Object Oriented Concepts and Programming	3	0	2	5	4
5.	3CP84	Information Technology Essentials	3	0	2	5	4
6.	3CP83	Programming with Python	3	0	2	5	4
7.	3IT85	Web Application and Development	3	0	2	5	4
8.	3IT86	Java Programing	3	0	2	5	4
9.	3IT87	Object Oriented Programming with C++	3	0	2	5	4
10.	3IT88	Mobile Application Development	3	0	2	5	4
11.	3EE82	Renewable Energy Technology	3	0	2	5	4
12.	3EE84	Industrial Automation	3	0	2	5	4
13.	3EL82	Basics of Embedded and IoT Systems	3	0	2	5	4
14.	3EL83	Sensor Technology	3	0	2	5	4
15.	3EC83	Embedded Systems and IOT	3	0	2	5	4

		Program Elective - II					
1	3PE44	Design of Machine Tools	3	0	2	5	4
2	3PE45	Advances in Manufacturing Processes	3	0	2	5	4
3	3PE46	Finite Element Analysis	3	0	2	5	4
		Program Elective -III					
1	3PE47	Lean & Agile Manufacturing	3	0	2	5	4
2	3PE48	Industrial Robotics	3	0	2	5	4
3	3PE49	Logistics & Supply Chain Management	3	0	2	5	4
		Semester 7					
Sr. No.	**Course Code**	**Name of Course**	**L**	**T**	**P**	**H**	**C**
1	4PE01	Operation Research	3	0	2	5	4
2	4PE02	Production & Operations Management	3	1	0	4	4
3	4PE03	Quality Management	3	0	2	5	4
4	4PE04	Industrial Engineering	3	0	2	5	4
5		Program Elective – IV	2	0	2	4	3
6		Program Elective - V	2	0	2	4	3
		Total	**16**	**1**	**10**	**27**	**22**
		Program Elective - IV					
1	4PE41	Allied Manufacturing Processes	2	0	2	4	3
2	4PE42	Computational Fluid Dynamics	2	0	2	4	3
3	4PE43	Rapid Prototyping and Additive Manufacturing	2	0	2	4	3
		Program Elective - V					
1	4PE44	Entrepreneurship Development	2	0	2	4	3
2	4PE45	Product Design & Development	2	0	2	4	3
3	4PE46	Flexible Manufacturing Systems	2	0	2	4	3
4	4PE47	Industry 4.0	2	0	2	4	3
		Semester 8					
1	4PE31	Project	0	0	30	30	15
		Total	**0**	**0**	**30**	**30**	**15**
		Total Credits Distribution	**104**	**5**	**104**	**213**	**157**

L=Lecture Hrs./wk; T=Tutorial Hrs./wk; P=Practical Hrs./wk; H=Total Contact Hrs./wk; C=Credits of Course

ANNEXURE –II: Syllabi for the courses offered in programme of studies leading to the degree of Bachelor of Technology (Production Engineering)

BS111: ADVANCED CALCULUS
CREDITS - 4 (LTP:3,1,0)

Course Objectives:

The basic necessity for the Foundation of Engineering & Technology being Mathematics, the main aim is, to teach Mathematical concepts, develop Mathematical skills & enhance thinking power of students.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	08
2	Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Differentiation of Hyperbolic and Inverse Hyperbolic functions, Successive differentiation, standard forms, Leibnitz's theorem and applications, power series, expansion of functions, Indeterminate forms and L'Hospital's rule; Maxima and minima.	08
3	Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	10
4	Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.	10
5	Sequence and Their Convergence, Convergence and Divergence of Infinite Series, Geometric Series, P-Test, A Necessary Condition for Convergence, Comparison Test, Ratio Test.	06
	Total	**42**

List of References:

1. Weir, M.D. et al., *Thomas' Calculus (*11*th Edition*), Pearson Education, 2008.
2. Grewal B. S., "*Higher Engineering Mathematics*", Khanna Publisher, New Delhi, (Latest Edition).
3. Sastry S. S., "*Engineering Mathematics – Vol. I and II*", Prentice Hall of India.
4. Stuart J., "*Calculus*", Cengage Learning, India Pvt. Ltd. (2008).

BS101: ADVANCED CALCULUS
CREDITS = 5 (LTP : 3,2,0)

Course Objectives:

The basic necessity for the Foundation of Engineering & Technology being Mathematics, the main aim is, to teach Mathematical concepts, develop Mathematical skills & enhance thinking power of students.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Marks Distribution				Total Marks
				Theory Marks		Tutorial / Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	2	0	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	08
2	Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Differentiation of Hyperbolic and Inverse Hyperbolic functions, Successive differentiation, standard forms, Leibnitz's theorem and applications, power series, expansion of functions, Indeterminate forms and L'Hospital's rule; Maxima and minima	08
3	Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	10
4	Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.	10
5	Sequence and Their Convergence, Convergence and Divergence of Infinite Series, Geometric Series, P-Test, A Necessary Condition for Convergence, Comparison Test, Ratio Test.	06
	Total	**42**

List of References:

1. Weir, M.D. et al., Thomas' Calculus (11th Edition), Pearson Education, 2008.
2. Grewal B. S., "Higher Engineering Mathematics", Khanna Publisher, New Delhi, (Latest Edition).
3. Sastry S. S., "Engineering Mathematics – Vol. I and II", Prentice Hall of India.
4. Stuart J., "Calculus", Cengage Learning, India Pvt. Ltd. (2008).

BS103: PHYSICS
CREDITS - 4 (LTP:3,0,1)

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)			Credits	Marks Distribution				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No	Topics	Teaching Hours
1.	**Properties of Matter** Concept of Load, Stress and Strain , Hook's Law, Stress-Strain Diagram, Ductility, Brittleness and Plasticity ,Elastic behavior of solids ,Working stress and factor of safety ,Factors affecting elasticity ,Types of Elasticity Twisting couple on a cylinder or wire-shaft, Torsional Pendulum, Cantilever-Depression of Cantilever, Young's modulus by Cantilever ,I-shape Griders ,Viscosity and comparison of viscosities	8
2.	**Waves, Motion and Acoustics** Simple Harmonic motion, Free, forced, resonance, damped and undamped vibration , Damped harmonic motion , Force vibration and amplitude resonance, Velocity resonance and energy intake , Wave motion, transverse and longitudinal vibration , Sound absorption and reverberation, Sabine's formula and usage (excluding derivation) Acoustic of building	10
3.	**Ultrasonic and Non distractive testing (NDT)** Ultrasonic waves, Properties of ultrasound, Production of ultrasonic waves, Piezoelectric and magnetostriction method, Detection of ultrasound, Application of ultrasound, Introduction of NDT ,Advantages of NDT,NDT through ultrasound	8
4.	**Optics** Introduction, Huygen's Principle, Superposition of waves and interference of light by wavefront splitting and amplitude splitting, Young's Double slit experiment, Newton's ring, Michelson's Interferometer, Farunhofer diffraction from a single slit and a circular aperture, Rayleigh criterion for limit of resolution and its application to vision, Diffraction grating and their resolving power.	8
5.	**Lasers** Properties of Laser, Einstein's theory of matter radiation : A and B coefficients, Amplification of light by population inversion, Different types of lasers, gas lasers (He-Ne) solid-state lasers(ruby), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, Applications of lasers in science, engineering and medicine.	8
	Total	**42**

List of References :

1. Dattu R Joshi, "*Engineering Physics"*, McGraw hill Publications
2. Shatendra Sharma & Jyotsan Sharma, "*Engineering Physics"* Pearson Publication
3. Barry J Goodno, James M. Gere, "*Mechanics of Materials*", SI Edition, 9th Edition, Published: 2018 Print ISBN: 9781337093354
4. A Ghatak, "*Optics"*, McGraw Hill Education

Suggested Practical List

1. Introduction to Lab
2. Error Analysis in Physical Measurements
3. Optical Fiber for measurement of Numerical Aperture and Acceptance Angle
4. Least Square Fitting.
5. Diffraction and interference experiments (from ordinary light or laser pointers); measurement of speed of light on a table top modulation; minimum deviation from a prism.
6. Measurement of the Distance using Ultrasonic Sensors.
7. Study of Object Detection using Ultrasonic Sensors.
8. Melde's Experiment Transverse and Longitudinal Modes
9. To determine the frequency of given laser source.
10. Frequency of AC Supply-Sonometer method
11. Wavelength of Light -Diffraction Grating Using LASER
12. Acoustic grating method set up for measurement of velocity of ultrasonic waves in liquid
13. Melde's experiment
14. Resonator
15. Study of Damped Simple Harmonic Motion
16. Newton's rings, Determination of using sodium light.
17. Calibration of Spectrometer & determination of unknown wavelength
18. Dispersive curve of a prism
19. Study of Fabry-Perot Etalon
20. Study of Lloyd's Mirror
21. Study of Double Refraction in Calcite Prism

ES102: ELECTRONICS WORKSHOP
CREDITS - 1 (LTP:0,0,1)

Course Objectives:

1. The goal of this course is to introduce basic principles of electronics workshop and establish the fundamentals of electronics components based projects as required for electronics and communication engineering students.
2. The course aims to make the student familiar with principles of electronics workshop like various electronics components, analog/digital troubleshooting, soldering techniques and PCB design, etc.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
0	0	2	1	00	00	40	60	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Electronics Components**: Resistor, Capacitor, Inductor, Diode, LEDs, Transistor, MOSFET, Thyristor, Relays, Op-Amp, ICs, Breadboard etc. Soldering techniques, stripping and tinning stranded wires, mounting components- plated through hole and surface mount technology, hand wire soldering, desoldering techniques, electrostatic discharge, SMD soldering techniques	06
2	**Analog Troubleshooting:** Electronics troubleshooting basics, troubleshooting with Oscilloscopes, signal injection and signal tracing, system analysis, diagnostics methods, servicing close loop circuits, troubleshooting noise and intermittent.	04
3	**Digital Troubleshooting:** Introduction to Superconductivity, General properties of superconductor Types of Superconductors, High Temperature Superconductors (only Definition), BCS Theory for Superconductivity, Applications of Superconductor	04
4	**Study of Soldering Techniques and PCB Design:** Students are expected to select any experiment. Soldering and testing is to be done for the selected experiment. Perform simulation of the same experiment by using CAD tools. Schematic as well as PCB design is to be carried out using CAD tools, Packages of Integrated Circuits (ICs) i.e. SOIC, PDIP,TQFP, MLFP, CBGA etc	06
5	**Design and Implementation of Analog/Digital/Mix Mode Project:** Students are expected to design any analog/digital/mix mode application of their choice. PCB design, fabrication of PCB, testing and implementation should be done. Documentation of the project is to be done in standard IEEE format. Project report should include abstract in maximum 100 words, keywords, introduction, design, simulation, implementation, results, conclusion and references. Example: Design and Implementation of DC Power Supply. (any other project can be taken in place of this example)	08
	Total	**28**

List of References:

1. Jean Andrews; "*Enhanced Guide to managing and maintain your PC",*Edition , 2001, Course Technology - Thomsan learning publishers.
2. Rashid M.H.; *"SPICE for Circuits and electronics using PSpice*"; Prentice Hall.
3. Boshsart;"*Printed Circuit Boards: Design and Technology"* Tata McGraw Hill OrCAD/PCB II, User's Guide.

ES103: BASIC ELECTRICAL ENGINEERING
CREDITS - 4 (LTP:3,0,1)

Course Objectives:

Electricity is the basic requirement for all citizens of a Country. It is also very important for all sectors of Industry, Engineering and Infrastructure. In view of this, it is desirable for all discipline engineering graduates to know the fundamental concepts of electrical engineering. This subject

deals with fundamental circuit analysis and solution methods, introduction to electrical machines, power converters and basics of domestic electrical installations.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8
2	**AC Circuits**: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.	8
3	**Transformers:** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	6
4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	8
5	**Power Converters:** DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.	6
6	**Electrical Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6
	Total	**42**

Suggested Text / Reference Books

1. D.P. Kothari and I. J. Nagrath, "*Basic Electrical Engineering*", Tata McGraw Hill,2010.
2. D.C. Kulshreshtha, "*Basic Electrical Engineering*", McGrawHill,2009.
3. Ritu Sahdev, *Basic Electrical Engineering*, (ISBN: 9789386173492), Khanna Book Publishing Co.
4. B. L. Theraja, "*A Textbook of Electrical Technology*" - Volume I and II, S. Chand Publishers, 2012
5. L.S. Bobrow, "*Fundamentals of Electrical Engineering*", Oxford University Press,2011.
6. E. Hughes, "*Electrical and Electronics Technology*", Pearson,2010.
7. V.D. Toro, "*Electrical Engineering Fundamentals*", Prentice Hall India, 1989.

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments–voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve non-linearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging – slip-ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters –PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switch-gear.

ES113: WORKSHOP PRACTICES – I
CREDITS - 2 (LTP:0,0,2)

Course Objective:

Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hands on skills required by the engineers working in the various engineering industries and workshops. The use of workshop practices in day to day industrial as well as domestic situation is of primordial importance for production engineers. This course is tailored to give the production engineers a considerable hands on feel of industrial shop floor practices.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
0	0	4	1	0	0	40	60	100

Contents and Practice:

Unit No.	Topics	Teaching Hours
1	Introduction to various shops / sections and workshop layouts. Safety norms safety equipment's to be followed in a workshop.	04
2	Demonstration & Practice on Carpentry, Fitting, Welding, Tin smithy, Plumbing, Machining and machine tools / equipment.	36
3	Students are required to prepare one job each in the following shops: Fitting, Carpentry, Tin smithy, Electric Arc welding / Resistance welding.	16
4	Assembly and disassembly of simple products.	
	Total	**56**

List of References:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "*Elements of Workshop Technology*", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "*Manufacturing Engineering and Technology*", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"*Manufacturing Technology – I*" Pearson Education, 2008.
4. Roy A. Lindberg, "*Processes and Materials of Manufacture*", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "*Manufacturing Technology*", Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

HS112: ENVIRONMENTAL SCIENCE
CREDITS - 0 (LTP:2,0,0)

Rationale:

To inculcate the environmental values translating into pro-conservation actions Honorable Supreme Court of India has made it 'mandatory' to introduce a basic course on environment at the undergraduate level.

Course Objectives:

1. Develop awareness about various environmental pollution effects and control measures.
2. Create awareness about environmental ethics.

Teaching and Assessment Scheme

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	0	0	30	20	00	00	50

Course Content:

Unit No.	Topics	Teaching Hours
1	**INTRODUCTION TO ENVIRONMENT** Definition, principles and scope of Environmental Science. Impacts of technology on Environment, Environmental Degradation, Importance for different engineering disciplines	02
2	**ENVIRONMENTAL POLLUTION** **Water Pollution**: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants **Air Pollution:** Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO_2, NOX, Auto exhaust, Effects of common air pollutants **Noise Pollution:** Introduction, Sound and Noise, Noise measurements, Causes and Effects **Solid Waste:** Generation and management **Bio-medical Waste:** Generation and management **E-waste:** Generation and management	12
3	**GLOBAL ENVIRONMENTAL** ISSUES Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change	07
4.	**SOCIAL ISSUES AND ENVIRONMENT** Role of an individual in prevention of environmental pollution. Environmental ethics: Issues and possible solution. Wasteland reclamation, consumerisms and waste products.	05
5	**CONCEPT OF 4R's** Principles, Application of 4R's :Reduce, Reuse, Recycle, Recovery	02
	Total	**28**

HS102: ENVIRONMENTAL SCIENCE
CREDITS - 0 (LTP : 2,2,0)

Rationale:
To inculcate the environmental values translating into pro-conservation actions Honorable Supreme Court of India has made it 'mandatory' to introduce a basic course on environment at the undergraduate level.

Course Objectives:
1. Develop awareness about various environmental pollution effects and control measures.
2. Create awareness about environmental ethics.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	2	0	0	35	15	30	20	100

Course Content:

Unit No.	Topics	Teaching Hours
1	**INTRODUCTION TO ENVIRONMENT** Definition, principles and scope of Environmental Science. Impacts of technology on Environment, Environmental Degradation, Importance for different engineering disciplines	02
2	**ENVIRONMENTAL POLLUTION** **Water Pollution**: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants **Air Pollution:** Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO_2, NOX, Auto exhaust, Effects of common air pollutants **Noise Pollution:** Introduction, Sound and Noise, Noise measurements, Causes and Effects **Solid Waste:** Generation and management **Bio-medical Waste:** Generation and management **E-waste:** Generation and management	12
3	**GLOBAL ENVIRONMENTAL** ISSUES Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change	07

Unit No.	Topics	Teaching Hours
4.	**SOCIAL ISSUES AND ENVIRONMENT** Role of an individual in prevention of environmental pollution. Environmental ethics: Issues and possible solution. Wasteland reclamation, consumerisms and waste products.	05
5	**CONCEPT OF 4R's** Principles, Application of 4R's :Reduce, Reuse, Recycle, Recovery	02
	Total	**28**

BS112: LINEAR ALGEBRA AND FOURIER SERIES
CREDITS - 4 (LTP:3,1,0)

Course Objectives:

The basic necessity for the Foundation of Engineering & Technology being Mathematics, the main aim is, to teach Mathematical concepts, develop Mathematical skills & enhance thinking power of students.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	Matrices: addition and multiplication by scalar, matrix multiplication; Linear systems of equations (homogeneous and nonhomogeneous), rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.	10
2	Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.	12
3	Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.	10
4	Periodic function, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion, Parseval's theorem.	10
	Total	**42**

List of References:

1. Howard A. and Chris R., "*Elementary Linear Algebra*", John Wiley & Sons, 2005.
2. Grewal B. S., "*Higher Engineering Mathematics*", Khanna Publisher, New Delhi, (Latest Edition).
3. Bali N. P. and Goyal M., "*Engineering Mathematics*", Laxmi Publication (Latest Edition).

BS102: LINEAR ALGEBRA AND FOURIER SERIES
CREDITS = 5 (L=3, T=2, P=0)

Course Objectives:
The basic necessity for the Foundation of Engineering & Technology being Mathematics, the main aim is, to teach Mathematical concepts, develop Mathematical skills & enhance thinking power of students.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	2	0	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	Matrices: addition and multiplication by scalar, matrix multiplication; Linear systems of equations (homogeneous and nonhomogeneous), rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.	10
2	Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.	12
3	Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.	10
4	Periodic function, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion, Parseval's theorem.	10
	Total	**42**

List of References:
1. Howard A. and Chris R., *"Elementary Linear Algebra*", John Wiley & Sons, 2005.
2. Grewal B. S., "*Higher Engineering Mathematics*", Khanna Publisher, New Delhi, (Latest Edition).
3. Bali N. P. and Goyal M., "*Engineering Mathematics*", Laxmi Publication (Latest Edition).

ES106: PROGRAMMING FOR ENGINEERS
CREDITS - 3 (LTP:1,0,2)

Course Objectives:

To enhance logical thinking and to impart basic programming skills.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
1	0	4	3	30	20	40	60	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Programming** Introduction to the idea of algorithm; Introduction to Programming (Flow chart/pseudocode); Computing Software: System Software, Languages, Tools;	2
2	**Vectors and Matrices** Creations of Vectors and Matrices, Mathematical Operations with Vectors and Matrices: Addition, Multiplication, Determinants, Matrix Inverse; Data Input/Output: Entering a Scalar, String, Vector and Matrix; Input/Output Data files	3
3	**Program Flow Control** Logical Operators, Writing and evaluation of conditionals and consequent branching, Iteration and loops.	4
4	**Basic Algorithm** Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs	5
5	**Functions** Functions (including using built in libraries), Function File, Sub function, Anonymous Function, Inline Function, Passing Array to function	Laboratory
6	**Plotting and Graphics** 2D Plotting: Annotations and Enhancements, Interactive Plotting, Animation; 3D Plotting: Lines, Surfaces;	Laboratory
	Total	**14**

List of References:

1. Edward B. Magrab and at. al., "*An Engineer's Guide to Matlab"*, Prentice Hall
2. Brian D. Hahn and Daniel T. Valentine, "*Essential MATLAB for Engineers and Scientists",* Third Edition, ELSEVIER
3. E. Balaguruswamy*, "Programming in ANSI C"*, Tata McGraw-Hill

ES109: ENGINEERING GRAPHICS AND DESIGN
CREDITS - 4 (LTP:2,0,2)

Course Objectives:

To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	4	4	30	20	40	60	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Engineering Graphics:** Drawing instruments and accessories, BIS – SP 46.	2 (Lab Hours)
2	Use of plane scales, Diagonal Scales.	2
3	**Orthographic Projections:** Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view	4
4	**Engineering Curves:** Classification and application of Engineering Curves, Construction of Conics, Cycloidal Curves, Involutes and Spirals along with normal and tangent to each curve	4
5	**Projections of Points and Lines:** Introduction to principal planes of projections, Projections of the points located in same quadrant and different quadrants, Projections of line with its inclination to one reference plane and with two reference planes. True length and inclination with the reference planes	4
6	**Projections of Planes:** Projections of planes (polygons, circle and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane	4
7	**Projections of Solids, Section of Solids and Development of Surfaces:** Classification of solids. Projections of solids (Cylinder, Cone, Pyramid and Prism) along with frustum with its inclination to one reference plane and with two reference planes, Section of such solids and the true shape of the section, Development of surfaces	7
8	**Isometric Projections and Isometric View or Drawing:** Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing of objects	3

Unit No.	Topics	Teaching Hours
9	**Computer Aided Drawing:** Design concepts**,** Introduction to AutoCAD, Basic commands for 2D drawing like: Line, Circle, Polyline, Rectangle, Hatch, Fillet, Chamfer, Trim, Extend, Offset, Dimension style, etc. Industrial Drawing symbols, Program specific commands and tools.	6 (Lab Teaching)
	Total	**28**

List of References:

1. N.D.Bhatt, *"Engineering Drawing*", 53rd Edition, 2014, Charotar Publishing house Pvt. Ltd. Anand and Gujarat.
2. P.J.Shah, *"A Text Book of Engineering Graphics"* S.Chand & Company Ltd. New Delhi.
3. P.S.Gill, *"A Text Book of Engineering Drawing, S*.K.Kataria & Sons, Delhi.
4. B. Agrawal and C M Agrawal, "*Engineering Drawing*", Tata McGraw Hill, New Delhi.

ES110: BASIC MECHANICAL ENGINEERING
CREDITS - 4 (LTP:3,0,1)

Course Objectives:

To Study the fundamentals of mechanical systems and appreciate significance of mechanical engineering in different fields of engineering.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Prime movers and its types, Concept of Force, Torque, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth law and First law	4
2	**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydro, Solar, Wind, and Bio-fuels, Environmental issues like Global warming and Ozone depletion	3

Unit No.	Topics	Teaching Hours
3	**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between c_p and c_v, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Polytropic process	5
4	**Properties of Steam:** Steam formation, Types of steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of steam tables, steam calorimeters	6
5	**Heat Engines:** Heat engine cycle and Heat engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles	5
6	**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, Functioning of different mountings and accessories	-
7	**Internal Combustion Engines:** Introduction, Classification, Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies	4
8	**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming	3
9	**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistaging	3
10	**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, Vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners	4
11	**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc)	-
12	**Transmission of Motion and Power:** Shaft and axle, Different arrangement and applications of Belt drive; Chain drive; Friction drive and Gear drive	-
13	**Engineering Materials:** Types, properties and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer	4
	Total	**41**

Note: Topic No. 6, 11 and 12 of the above syllabus are to be covered in Practical Hours.

List of References:

1. N M Bhatt and J R Mehta, "*Elements of Mechanical Engineering*", Mahajan Publishing House
2. Pravin Kumar, "*Basic Mechanical Engineering"*, Pearson Education
3. G.S. Sawhney, "*Fundamental of Mechanical Engineering"*, PHI Publication New Delhi
4. Sadhu Singh, "*Elements of Mechanical Engineering"* S. Chand Publication
5. B.K. Agrawal, "*Introduction to Engineering Materials"* McGraw Hill Publication, New Delhi

ES114: WORKSHOP PRACTICES – II
CREDITS - 2 (LTP:0,0,2)

Course Objective:

This course is focussed to give students a hands on feel of varied manufacturing processes. The common workshop practices for different manufacturing processes will help build the understanding of the manufacturing process sequence to produce simple industrial jobs and impart hands on skills to perform the same. The knowledge gained in the subject would become a prelude to subsequent courses in manufacturing and production technology in successive semesters.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
0	0	4	2	0	0	40	60	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Demonstrations & practice of basic manufacturing processes:** casting, forming, joining and advanced manufacturing methods.	04
2	**Demonstrations & practice on tools:** hand tools, machine tools, power tools, basic measuring and gauging instruments, marking and measurement, power transmission elements.	06
3	**Demonstrations & practice on machines:** Lathe Machine, Drilling Machine, Milling Machine, Shaper, Planer, Slotter, Grinding Machine, Hydraulic Press, Rolling Mill, Hacksaw Machine.	12
4	**Open Ended Problems:** It is preferred apart from above practice jobs a group of students has to undertake one open ended problem and produce the same.	06
	Total	**28**

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "*Elements of Workshop Technology*", Vol. I 2008 and Vol. II 2010, Media Promoters and Publishers Private Limited,

Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "*Manufacturing Engineering and Technology*", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu, "*Manufacturing Technology – I*" Pearson Education, 2008.
4. Roy A. Lindberg, "*Processes and Materials of Manufacture*", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "*Manufacturing Technology*", Vol. I and Vol. II, Tata McGraw-Hill House, 2017.
6. Pandey P.C. and Shan H.S. "*Modern Machining Processes*" Tata McGraw-Hill, New Delhi.
7. V. K. Jain, "*Advance machining processes*", Allied publisher

HS101: ENGLISH
CREDITS - 3 (LTP:2,0,1)

Course Objectives:

To acquaint BE students with the basics of English. The curriculum intends to familiarize students with LSRW Skills and provides exposure and practice in all four aspects to equip them with the useful language competencies and confidence to communicate well. The course accentuates good drilling in practicum in order to enable students to learn, perform and enhance their accuracy and skills in English language to excel in their field of specialization

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Vocabulary Building** The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations. General English words and their technical equivalent words	4
2	**Basic Writing Skills** Sentence Structures. Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence and Cohesion, Organizing principles of paragraphs in documents, Techniques for writing precisely	6

Unit No.	Topics	Teaching Hours
3	**Identifying Common Errors in Writing** Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés, Collocations	6
4	**Nature and Style of sensible Writing** Types of writing- descriptive, narrative, argumentative, Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion	4
5	**Writing Practices** Paragraph Writing: Topic sentence, supportive sentences and conclusion, Précis Writing, Essay Writing	4
6	**Language Skills** (This unit involves interactive practice sessions In Language Lab) Listening Comprehension, Reading Comprehension, Writing Skills (Permission letter, Invitation letter, Acknowledgement letter, Reporting complaint/grievance), Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues Communication at Workplace, Interviews, Formal Presentations, Public Speeches: Talking about self (Professional Setting, social setting), Introduction of Speakers, Vote of thanks	6
	Total	**30**

Language Lab Activities:

Sr. No.	Language Laboratory Activities	Duration	Nature of Activities
1	Listening Comprehension	1	Individual Task
2	Reading aloud stories - developing dialogues - deciding roles and enactment and performance analysis	2	Group work
3	Dialogue Writing (Cue cards)	1	(Team Work- Teacher Guided)
4	Reading Comprehension	2	Individual Tasks & Group Tasks (Digital Language Lab)
5	Note Taking and Note Making	1	
6	Book/Story Review/Article Review	1	
7	Group Discussion	1	
8	Short Oral Presentations (preferably recorded for self-analysis)	1	
9	Extempore (preferably recorded for self-analysis)	1	Individual Task
10	ICT Based presentations/ Technology based presentation	2	1 in Group & 1 individual
11	Graph/Chart Interpretation	1/2	Individual Task

Sr. No.	Language Laboratory Activities	Duration	Nature of Activities
12	Diagram illustration	1/2	Individual Task

List of References:

1. Michael Swan, "*Practical English Usage*". OUP. 1995.
2. F.T. Wood, "*Remedial English Grammar*". Macmillan.2007
3. William Zinsser, "*On Writing Well"*, Harper Resource Book. 2001
4. Liz Hamp-Lyons and Ben Heasly, *"Study Writing"*. Cambridge University Press. 2006.
5. Sanjay Kumar and PushpLata, "*Communication Skills"* Oxford University Press. 2011.
6. *"Exercises in Spoken English",* Parts. I-III. CIEFL, Hyderabad. Oxford University Press
7. Michael McCarthy& Felicity O' Dell, "*English Vocabulary in Use".* CUP 1994
8. Michael McCarthy& Felicity O' Dell, "*English Collocations in Use"*. CUP 2005
9. "Writing Skills: Success in 20 Minutes a Day". .GP Goodwill's 2013
10. Judith F. Olson, "Write Better; Speak better". Reader's Digest.1998
11. *"How to Say It"*, Third Edition: Choice Words, Phrases, Sentences, and Paragraphs for Evry Situation Original Edition, Rosalie Maggio, Prentice Hall Press, 2009

2BS02: DIFFERENTIAL EQUATIONS AND STATISTICS
CREDITS - 4 (LTP:3,1,0)
2nd Year, B. Tech. (Civil, Mechanical, Production)

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Ordinary differential equations of higher orders** Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	10
2	**Partial Differential Equations** First order partial differential equations, solutions of first order linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Separation of variables method to solve partial differential equations	12

Unit No.	Topics	Teaching Hours
3	**Basic Statistics:** Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.	8
4	**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	8
5	**Small samples:** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	4
	TOTAL	**42**

List of References:

1. Erwin Kreyszig, "*Advanced Engineering Mathematics*", 9th Edition, John Wiley & Sons, 2006.
2. Chandrika Prasad and Reena Garg, "*Advanced Engineering Mathematics"*, Khanna Book Publishing Co. (P) Ltd., Delhi
3. N.P. Bali and Manish Goyal, "*A text book of Engineering Mathematics"*, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publishers, 35th Edition, 2000.
5. W. E. Boyce and R. C. Di Prima, "*Elementary Differential Equations and Boundary Value Problems*", 9th Edition, Wiley India, 2009.
6. S. C. Gupta, V. K. Kapur, "*Fundamental of Statistics*", Sultan Chand & Sons, India,
7. S. Ross, "*A first course in Probability",* Pearson Education India, 2002.
8. Richard A. Johnson, Miller and Freund's – "*Probability and Statistics for Engineers*", Prentice Hall of India, 2011.

Course outcome:

At the end of this course students will be able to

1. Understand effective mathematical tools for the solutions of ordinary and partial differential equations
2. Analyze and solve ordinary and partial differential equations.
3. Apply effective mathematical tools for the solutions of ordinary and partial differential equations.
4. Understand the concepts and tools of Statistics.
5. Analyze and solve various engineering problems through the tools of Statistics.
6. Adapt tools of applied statistics and sampling theory and apply them in engineering problems.

2PE01: MATERIAL SCIENCE AND PHYSICAL METALLURGY
CREDITS - 4 (LTP:3,0,1)

Course Objective:
To enable students to acquire and use the basic concept of selection, processing & non-destructive testing of materials with a special focus on ferrous & non-ferrous metals/alloys for their engineering applications.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Material Science & Physical Metallurgy:** Classification of engineering materials, Engineering requirements of materials, Factors affecting selection of engineering materials for engineering applications through Structure-Property-Performance co-relationship, Introduction to levels of structures based on level of observation (Macro, Micro, Crystal, etc.), Co-relation of properties with type of structures and methods/tools to reveal them.	03
2	**Crystal Imperfections & Diffusion Processes:** Ideal & imperfect crystals, Types of imperfections, Effects of crystal imperfections on properties of materials, Significance of imperfections, Strengthening mechanisms in metals/alloys using imperfections. **Diffusion Processes:** Types, Mechanisms, Laws of diffusion and Applications of diffusion in engineering processes.	06
3	**Effects of strain hardening on properties:** Recovery, Recrystallization& Grain growth of strain hardened materials and their effects on properties of materials.	02
4	**Solidification of Metals & Alloys and Principles of Alloy Formation:** **Solidification:** Crystallization, Mechanism of crystallization – nucleation & growth, Factors influencing nucleation & growth, Nucleation and growth during freezing of pure metal and alloy ingot casting and resulting structures, Effects of structures on mechanical properties of metals/alloys, Methods to control grain structure resulting from solidification, Solidification defects such as porosity, shrinkage, pipe, etc. & remedies for eliminating or reducing them. **Principles of Alloy Formation:** Terminology used in phase equilibrium, Unary & Binary phase equilibrium diagrams, Gibb's phase rule, Constitution of Alloys: Purpose of alloying, solid	10

Unit No.	Topics	Teaching Hours
	solutions & compounds, Hume-Rothery rules, Cooling curves for pure metal, compound & solid solutions, Binary phase equilibrium diagrams: Isomorphous system, lever rule & chemical composition rule, different reactions like eutectic, euctectoid, peritectic & peritectoid on phase diagrams, Non-equilibrium cooling & concept of coring.	
5	**Iron-Iron Carbide Phase Equilibrium Diagram & Heat Treatments of Steels:** Introduction, Allotropy of iron, Iron-Iron Carbide equilibrium system- phases & their properties, various reactions of the iron-iron carbide equilibrium diagram, Alloy groups on iron-iron carbide equilibrium diagram & their characteristics in general, Equilibrium cooling of hypoeuctectoid, eutectoid & hypereutectoid steels, their resulting microstructures and correlated properties and applications. IS and ISO Coding, Different specifications & designations of steels and cast irons. **Heat Treatment of Steels:** Introduction & definition, Time-Temperature-Transformation Diagram (TTT-diagram), Isothermal & Continuous Transformations (CCT), Heat treatment processes with thermal cycles for plain carbon steels such as different types of Annealing, Normalizing, Hardening, Tempering, Austempering and Case hardening methods: Carbursing, Nitriding, Cyaniding, Flame hardening, Induction Hardening, and Applications of above methods in industrial practices, Concept of Hardenability & its significance.	10
6	**Alloy Steels and Cast Irons:** **Alloy Steels:** Introduction, General effects of alloying elements on ferrite and carbide, formation, Transformation temperature, Types of Alloy Steels: Chromium, Manganese, Molybdenum Steels, Stainless Steels and there ISO Codification. **Tool Steels:** Classification, properties, applications, IS & ISO Codifications. **Cast Irons:** Introduction & Classification, Iron-Iron carbon & Iron-Iron carbide diagrams, Transformation resulting into White cast iron, Grey cast iron, Malleable cast iron, Nodular cast iron (SG iron) and Alloy cast irons, their microstructures, correlated properties and applications, IS codifications for cast irons. **Non-ferrous Metals & Alloys:** Compositions, Properties & Application of Aluminum & its alloys and Copper & its alloys.	11
*	**Non Destructive Testing:**(To be covered in Laboratory Practical) Introduction, advantages, disadvantages of Non Destructive Testing (NDT), Comparison of NDT with Destructive Testing (DT), Basic Elements of any NDT Method, Non Destructive testing of materials such as Dye (Liquid) Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing. Radiography Testing with their principle, capability of the methods, the steps in test methods, relative merits, demerits and applications	
	Total	**42**

List of References:

1. Donald R. Askeland and Pradeep P. Phule, "*The Science and Engineering of Materials*", 6th Edition, Cengage Learning.
2. W F Smith, *"Principles of Materials Science and Engineering",* McGraw Hill.
3. R. Balasubramaniam, *"Callister's Material Science and Engineering"*, 2/e, Wiley India
4. Sydney H. Avner, *"Physical Metallurgy"*, Tata McGraw-Hill.
5. Baldev Raj, T. Jayakumar and M. Thavasimuthu, *"Practical Non-Destructive Testing"*, Narosa Pub. House.
6. Richard A. Flinn and Paul K. Trojan, *"Engineering Materials and their Applications*", Jaico Publishing House.
7. James F. Shackleford, *"Introduction to Material Science for Engineers"*, 7th Edition (International); Pearson/Prentice Hall (2009).
8. George F. Vander Voort, *"ASM Handbook Vol. 9: Metallography and Microstructure",* ASM International (2004).
9. K. I. Parashivamurthy, *"Materials Science and Metallurgy*", Pearson Education.
10. James A. Jacobs, Thomas F. Kilduff, *"Engineering Material Technology"*, 5th Edition, Pearson/Prentice Hall (2004).
11. Michael F. Ashby & David R. H. Jones, *"Engineering Material 2: An Introduction to Microstructure, Processing & Design"*, 3rd edition, Butterworth-Heinmann (2006).
12. Robert E. Reed Hill, *"Physical Metallurgy Principles"*, Second Edition, Cengage Learning (2010).

Course Outcomes (COs):

At the end of this course students will be able to ……

1. Develop understanding of structure-property-performance relationship for the material selection with a special focus on metals/alloys.
2. Understand the rationale of given heat treatment cycle for ferrous and nonferrous group of materials for the given engineering application.
3. Learn the basic skills of metallographic practices and understand the basic concept of nondestructive testing for detecting internal defects in the material.
4. To understand the mechanism of solidification & appreciate its significance in casting/welding.

2ES03: MECHANICS OF SOLIDS
CREDITS: - 4 (LTP:3,0,1)

Course Objective:

This course is to introduce the basic principles of engineering mechanics and Mechanics of deformable bodies with emphasis on their analysis and application to practical engineering problems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme		Total Marks
L	T	P	C	Theory Marks	Practical Marks	

				ESE	CE	ESE	CE	150
3	0	2	4	60	40	20	30	

Course Contents:

Unit No.	Topic	Teaching Hours
	Module 1	
1	**Fundamentals of Statics**: **Coplanar concurrent and non-concurrent force system: Resultant, Equilibrant, Free body diagrams.** Coplanar concurrent forces: Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Equilibrium conditions for coplanar concurrent forces, Lami's theorem. Application of statically determinate pin – jointed structures. Coplanar non-concurrent forces: Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent forces by analytical method, Equilibrium conditions of coplanar non-concurrent force system.	07
2	**Centroid and moment of inertia:** Centroid: Centroid of plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus first and second theorems. Moment of inertia of planar cross-sections: Derivation of equation of moment of inertia of standard lamina using first principle, Parallel & perpendicular axes theorems, polar moment of inertia, and radius of gyration of areas. Examples related to moment of inertia of composite geometry,	06
3	**Columns and Struts:** Buckling of columns, different end conditions, effective length, least radius of gyration, Euler's and Rankine's formulae	05
4	**Applications of fundamentals of statics** Statically determinate beams: Types of loads, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment, Bending moment and shear force diagrams for beams subjected to various types of loads and their combinations; Point of contra-flexure, point & magnitude of maximum bending moment, maximum shear force.	07
5	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.	05
6	**Simple stresses & strains** Basics of stress and strain: Application of normal stress & strains: Homogeneous and composite bars having uniform & stepped sections subjected to axial loads and thermal loads, analysis of homogeneous prismatic bars under multidirectional stresses. **Principle stresses and strains:** Two dimensional system, stress at a point on a plane, principal stresses, strains and principal planes, Mohr's circle of stress, ellipse of stress, strain and their applications.	08

Unit No.	Topic	Teaching Hours
7	**Theory of failures:** (a) Maximum Principal stress theory (due to Rankine) (b) Maximum shear stress theory (Guest - Tresca) (c) Maximum Principal strain (Saint - venant) Theory (d) Total strain energy per unit volume (Haigh) Theory (e) Shear strain energy per unit volume Theory (Von – Mises & Hencky)	03
8	**Deflection of beams:** Only by virtual load method	04
	Total	**45**

List of Experiments:
The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

Mechanics of rigid body
1. Equilibrium of coplanar concurrent forces
2. Equilibrium of coplanar non-concurrent forces
3. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
4. Determination of member force in a triangular truss

Mechanics of deformable body
1. Torsion test on cast iron
2. Determination of hardness of metals: Brinell and Rockwell hardness test
3. Determination of impact value/toughness of metals: Izod impact test
4. Determination of compressive strength
5. Determination of tensile strength of metals
6. Determination of shear strength of metals

List of References:
1. S. B. Junnarkar and H. J. Shah, "*Applied Mechanics*", Charotar Publishing House Pvt. Ltd.
2. S. B. Junnarkar and H. J. Shah, "*Mechanics of Structure Vol. I*", Charotar Publishing House Pvt. Ltd.
3. P. J. Shah, "*Mechanics of Solids*", S. Chand, New Delhi.
4. R. S. Khurmi, "*Engineering Mechanics*", S. Chand, New Delhi.
5. L. A. Srinath, "*Theory of failures*"

2HS02: ECONOMICS AND MANAGEMENT
CREDITS – 3 (LTP:3,0,0)

Course Objectives:
To provide the basics of economics and management applicable to various branches of engineering. The subject will enable them to connect the concepts of economics to the practical situation and take appropriate decision. It will help select projects and price the products as well as to fix capacity utilization to maximum benefits. The subject provides understanding towards implications of monetary and fiscal policy variables on business organizations. It will prepare

students towards entrepreneurship and identify business opportunity, prepare business plans and to judge business feasibility.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Economics:** Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand and Supply: meaning, determinants, law of demand, law of supply, equilibrium between demand & supply ,elasticity of demand, price elasticity, income elasticity, cross elasticity Cost: Meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost Break even analysis: Meaning, explanation, numerical **Markets:** Meaning, types of markets & their characteristics Perfect competition, monopoly, monopolistic competition anti-competitive laws and concept of dumping, Inflation, types of inflation, measures to control inflation, Fiscal and monetary policy. National Income, NI current price and NI at market price, GNP,GDP,NNP,NDP and personal and disposable income	20
2	**Introduction to Management**: Definition, nature and scope of management. Functions of Management, Planning, Organizing, Staffing, Directing and Controlling Introduction to Marketing Management: Marketing Mix, Marketing v/s Selling, Market segmentation and Holistic marketing	5
3	**Introduction to Financial Accounting and Costing**: Costing, Concepts of Costing, Balance Sheet, Investment Appraisal-Net present Value (NPV), Payback period, Internal Rate of Return (IRR), Depreciation, Numerical	6
4	**Entrepreneurship:** Concepts, Importance; Characteristics of a Successful Entrepreneur, Problems faced by Entrepreneurs, Types of Entrepreneur, Creativity, Innovation and Entrepreneurship.	6
5	**Formalities For Setting Up of A Small Business Enterprise**: Identifying The Business Opportunity; Growth of a Business Idea; Business Plan Preparation	5
	Total	**42**

List of References:

1. Dewett, K.K. "*Modern Economic Theory"*, S. Chand & Company Ltd.
2. Ahuja, H.L. "*Advanced Economic Theory",* S. Chand & Company Ltd.

3. Gail Freeman-Bell and James Balkwill, "*Management in Engineering"*, Prentice Hall of India.
4. James A .F. Stoner, R. Edward Freeman, Daniel R. Gilbert. Jr, "*Management",* Pearson, Lt. Ed.
5. Hishrich Robert, Peters Michael and Sheperd Dean, "*Entrepreneurship",* Tata McGraw-Hill
6. Roy Rajiv, *"Entrepreneurship",* Oxford, Latest Edition.
7. Pednekar Achut, *"Entrepreneurship"* Himalaya Publishing, Latest Edition.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand and apply the basics of economics, demand, demand forecasting, elasticity and management to engineering areas.
2. Apply the basics of project planning, project evaluation; break even, depreciation, quality concepts and costing and et al to engineering.
3. Analyze product development, product life cycle and its advantages to the organization.
4. Evaluate the need of human resource development, recruitment and training and its advantages to the organization
5. Develop Motivation towards Entrepreneurship and Innovation and thus design business plan and analyze scope and profitability

2PE02: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER
CREDITS - 4 (LTP:3,1,0)

Course Objective:

To understand the basic concepts of engineering thermodynamics, first & second laws of thermodynamics and fundamentals of three modes of heat transfer: conduction, convection and radiation.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Engineering Thermodynamics:** Introduction, Thermodynamic Systems, Macroscopic and Microscopic points of view, Pure substance, Concept of continuum, Thermodynamic Equilibrium, Properties of systems, State, Process, Cycle, Point function, Path function, Temperature, Zeroth law of Thermodynamics, Reversible and Irreversible processes, Energy, work and heat, Quasi static process, Work Transfer-Displacement work, Electrical Work, Shaft work, Paddle wheel work and flow work, Heat transfer-Specific heat and Latent heat.	07

Unit No.	Topics	Teaching Hours
2	**First law of Thermodynamics:** First law of Thermodynamics, Application of First law to a process, Energy- a property of system, Control volume, Enthalpy, Application of First law of thermodynamics to closed system, Steady Flow Energy Equation, Engineering applications of Steady flow energy equation.	07
3	**Second law of Thermodynamics:** Limitations of First law, Introduction to Second law, Energy reservoirs, Heat engines, Heat pump and refrigerator, Kelvin-Plank and Clausius statements of second law, Equivalence of Kelvin-Plank and Clausius statements, Reversibility and Irreversibility, Carnot cycle, Carnot's theorem, Corollary of Carnot theorem, Efficiency of reversible heat engine, Entropy, Third law of thermodynamics.	07
4	**Introduction to Heat Transfer and Heat Conduction:** Modes of heat transfer, General laws of heat transfer, General heat conduction equation in Cartesian and Cylindrical coordinates, Heat conduction through plane and composite wall, Heat conduction through hollow and composite cylinders, Critical thickness of Insulation, Heat transfer from Extended Surfaces (Fins).	08
5	**Heat Convection:** **Forced Convection**: Laminar flow: Laminar flow over a flat plate, Laminar tube flow, Turbulent flow: Turbulent tube flow. **Free Convection**: Characteristic parameters in free convection, Momentum and Energy equation for laminar free convection, heat transfer on a flat plate, Integral equations for momentum and energy on a flat plate.	08
6	**Radiation:** Introduction, Surface emission properties, Absorptivity, Reflectivity and transmissivity, concept of black body, The Stefan Boltzmann law, Kirchoff's law, Planck's law, Wien displacement law.	05
	Total	**42**

List of References:

1. YunusCengel and Boles, *"Thermodynamics: An Engineering Approach*", Eight edition, Mc-Graw Hill education, 2014.
2. Borgnakke and Sonntag, "*Fundamentals of Thermodynamics*", Seventh edition, Wiley India Pvt. Ltd., 2008.
3. P. K. Nag, "*Engineering Thermodynamics*", Fifth edition, Mc-GrawHill education, 2013.
4. Er. R.K Rajput, "*A textbook of Engineering Thermodynamics*", Laxmi Publications.
5. Er. R.K Rajput, "*Heat and Mass Transfer*", S. Chand Publications.
6. Incropera and Dewitt, "*Fundamentals of Heat and Mass Transfer",* Seventh edition, Wiley India edition, 2011.
7. Cengel and Ghajar, "*Heat and Mass Transfer: Fundamental and Applications*", Fourth edition, Mc-Graw Hill education, 2011.
8. J. P. Holman, "*Heat Transfer*", Nineth edition, Mc-Graw Hill education, 2008.
9. S. P.Sukhatme, "*A Text book on Heat Transfer*", Fourth edition, University press, 2005.
10. P. K. Nag, "*Heat and Mass Transfer*", Third edition, Tata Mc-Graw Hill education, 2007.

Course Outcomes:

At the end of this course students will be able to ……

1. Learn basic concepts of engineering thermodynamics & apply laws of thermodynamics to various engineering systems.
2. Compare heat and work, and analyze heat engine, refrigerator and heat pump.
3. Understand various modes of heat transfer and analyze steady state and transient heat conduction in solids.
4. Investigate heat transfer by forced and natural convection.
5. Examine heat transfer by thermal radiation and evaluate combined modes of heat transfer in manufacturing processes.

2PE03: DIMENSIONAL METROLOGY
CREDITS - 4 (LTP:2,0,2)

Course Objective:

To understand the basic principles of dimensional measuring instruments and precision measuring techniques so that the requirements of dimensional and other accuracy control can be inculcate for achieving quality and reliability in the service of any product.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	4	4	30	20	40	60	150

Course Contents:

Unit. No.	Topics	Teaching Hours
1	**Introduction to Metrology**: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Standards of measurement, line and end standards, International Standardization, Accuracy and precision of measurements.	06
2	**Linear Metrology: (In Practical)** Instruments with Vernier and Micrometer principle, Telescopic gauge, Bore gauge, Slip gauges, Error analysis, Calibration of instruments.	10
	Comparators: (Theory+Practical) Characteristics of a comparator, Mechanical comparators and Pneumatic comparator.	
	Miscellaneous measurements: (In Practical) Taper measurement, Angle measurement, Radius measurement	12

Unit. No.	Topics	Teaching Hours
3	**Linear Tolerancing and GD&T:**	
	Limits fits and tolerances: Interchangeability, selective assembly, limits, fits and tolerances, limit gauging, design of limit gauges.	07
	Geometrical, Dimensioning and Tolerancing: (In Practical) G D &T Fundaments and interpreting the drawing, Measurement of straightness, flatness, squareness, parallelism, roundness, cylindricity, coaxiality, run out on different machine tools.	12
	Interferometry: (In Practical) Principle of interference, analysis of interference pattern, Flatness measurement interferometer, testing of slip gauges.	
4	**Screw thread and Gear teeth metrology: (In Practical)** **Screw Thread Measurement:** Study of elements of screw thread, measurement of elements of external screw thread, Floating carriage diameter measuring machine, wire method to measure effective diameter of external screw thread, error analysis in screw thread elements.	06
	Gear Measurement: (Theory +Practical) Introduction, types of gears, Spur gear terminology, measurement of tooth thickness by Gear tooth vernier caliper method, constant chord method, Base tangent method, measurement over pins method, Parkinson gear tester.	14
5	**Measurement of Surface finish:** Terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish software.	07
	Recent trend in Metrology: Coordinate Measuring machine, profile projector, measuring microscope.	
	Total Hrs.(L)	**28**
	Total Hrs.(P)	**56**

List of References:

1. I.C. Gupta., "*A textbook of Engineering Metrology*", Dhanpat Rai Publication.
2. R. K. Jain., "*Engineering Metrology*", Khanna Publishers.
3. Khare M K, "*Dimensional Metrology*", Oxford-IBH Publishers.
4. N. D. Bhatt, "*Machine Drawing*", Charotar Publication.
5. P. S. Gill,"*Geometric Dimensioning & Tolerancing*", Kataria & Sons.
6. Gene R Cogorno, "*Geometric Dimensioning and Tolerancing for Mechanical Design*", Elsevier Science.
7. Meadows D, "*Geometric Dimensioning and Tolerancing*", CRC press.

Course Outcomes:

At the end of this course students will be able to …

1. Calibrate instruments like vernier caliper and micrometer.
2. Check linear and angular dimension.

3. Read Engineering drawing with linear and geometrical tolerances.
4. Calibrate external screw gauge.
5. Analyze appropriate method to check spur gear parameters.
6. Understand surface topology and surface roughness parameters which are used in drawing.

2PE04: MACHINING PROCESSES
CREDITS - 4 (LTP:2,0,2)

Course Objective:
To familiarize with fundamentals of different machining processes

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	4	4	30	20	40	60	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Manufacturing and Basics of Machine Tools:** Importance of manufacturing, economic and technological definitions of manufacturing, Classification of manufacturing processes. Selection of manufacturing process. Classification of machine tools, Basic motions in various machines tools, Specification, accessories, work holding and tool holding attachments used in various machine tools such as lathe, capstan and turret lathe, single spindle automate, shaper, planer, milling, grinding, broaching, sawing.	5
2	**Metal Cutting Principles and Lathe Operations:** Different types of cutting tools, cutting tool materials, nomenclature of single point and multi point cutting tools. Types of lathe, concept of cutting speed, feed and depth of cut and MRR for various machine tools under consideration. Tool life, cutting fluids- types and applications, merchant circle diagram, cutting force measurement, chip removal, different type of coolant. Lathe operations such as turning, grooving, thread cutting, knurling, chamfering, parting, hobbing, counters sinking, grinding, slotting, gear cutting & slotting on lathe using attachment, process parameters in lathe operations, methods of taper turning and its calculation, chip breakers, thread cutting on lathe, use of tap-die and its calculations, machining time and cost calculation.	9
3	**Drilling, Boring and Reaming:** Fundamentals of drilling operation, twist drill geometry, gang and multiple spindle drilling, deep hole drilling, counter sinking, counter boring, spot facing, tapping, reaming. Purpose of boring operation, horizontal and	6

Unit No.	Topics	Teaching Hours
	vertical boring machines, Jig boring, types of reaming. Process parameters in drilling, allied operations, machining time and cost calculation.	
4	**Milling:** Principle, construction and types of milling. Concept of up-milling and down-milling, types of milling cutters, different types of milling operations, in-line, gang and straddle milling. Cutting conditions in milling, Indexing types, operation and its set up. Process parameters in milling, machining time and cost calculation.	6
5	**Shaping, Planning, and Slotting:** Shaper: Working principle, mechanism, operations of mechanical shaper and hydraulic shaper. Planer: Working principle, mechanism, operations of planer. Slotter: Working principle, mechanism, operations of slotter. Machining time and cost calculation.	5
6	**Grinding:** Characteristic of grinding process, grinding wheel and its designations, Operations and applications of surface, cylindrical and centreless grinding processes, dressing, truing and balancing of grinding wheels, abrasives, process parameters in grinding operations, machining time and cost calculation.	6
7	**Broaching and Sawing and Gear Machining:** Broaching: Fundamentals of broaching, broaching tool terminology, operation, types, advantages and limitations of broaching. Sawing: Operation, Saw blades, mounting of power hacksaw and band saw blade. Gear Machining: Differentiating between gear manufacturing and form cutting, gear shaving, hobbing, gear grinding, honing, lapping, gear manufacturing on lathe and shaper using attachment. Alignment Test for various machine tools, Attachments for various machine tools (To be covered in Practical)	5
	Total	**42**

List of References:

1. Rao P. N., "*Manufacturing Technology (Vol. 2)"*, Tata Mc Graw-Hill.
2. Hajra Choudhury S. K., Bose H. K., Hajra Choudhury A. K., "*Elements of Workshop Technology (Vol. II, 12th Edition)",* Media promoters and Publishers Pvt. Ltd.
3. Raghuwanshi B. S., "*A Course in Workshop Technology (Machine Tools Vol. II)",* Dhanpat Rai & Sons.
4. Khanna O.P and Lal M, "*A Text book of Production Technology (Vol. II)",* Dhanpat Rai Publications (P) ltd.
5. HMT, "*Production Technology",* Tata Mc Graw-Hill
6. W.A.J. Chapman, "*Workshop Technology (Vol. I, II & III)"*, CBS publication.
7. R. K. Jain, "*Production Technology"*, Khanna publishers.

Course Outcomes:

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

1. Analyze the structure, basic elements and working of general purpose machine tools.

2. Comprehend basic mechanisms such as drive, speed, feed, indexing mechanisms and process principle and machining science for general purpose machine tools and its applications.
3. Calculate the cutting parameters like cutting speed, feed, and depth of cut, machining time and other with material removal rate for conventional machining processes.
4. Inspect the alignment of machine tools and use attachments for various machine tools.

2PE05: KINEMATICS AND DYNAMICS OF MACHINES
CREDITS - 4 (LTP:3,0,1)

Course Objective:
Develop skill of finding analytical and graphical solution of motion characteristics for a given mechanism.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit. No.	Topics	Teaching Hours
1	**Basic concept of Mechanism and Machines:** Introduction, Mechanism and Machine, Types of motions, Link, Kinematic Pair, types of kinematic pairs, kinematic chain and their classification, differentiate mechanism, machine and structure, Degree of Freedom, Mobility of Mechanisms, Inversions of four–bar chain and single slider crank chain, various types of quick return motion mechanism, Pantograph, straight line motion mechanisms, Hook's Joint.	9
2	**Motion Analysis:** Angular and linear velocities of link, analysis of velocity by Instantaneous Centre Method, analysis of velocity and acceleration by Relative Velocity Method for slider-crank chain and four- bar chain mechanism including Coriolis component of acceleration.	7
3	**Power Transmission system,** **Belt drive:** Geometrical Configuration: Analysis of forces and power transmission, effects of centrifugal force, creep and initial tension. **Gears Trains:** Classification of gear trains, simple gear trains, compound gear trains, epicyclic gear trains, gear train application to machine tools, Torque and load distribution in epicyclic gear train and acceleration of a geared system.	6
4	**Cams Design:** Types of cam and followers, drawing a cam profiles for a given displacement-time diagram, analysis of cam profile with specified contours. **Flywheel Design:** Design of Flywheel for press tool operations.	8

Unit. No.	Topics	Teaching Hours
5	**Dynamic force analysis of Mechanism:** Dynamic analysis of four link and slider crank chain mechanism, Engine force analysis, Turning moment on crank shaft, Inertia force in reciprocating engines by graphical method (Klein's Construction) considering mass of Connecting Rod, Inertia of connecting rod and correction couple, Inertia force in reciprocating engines by analytical method.	6
6	**Vibrations and Balancing:** **Vibrations:** Introduction, Basic features of vibration systems, types of vibration, causes of vibrations. Free vibration, damped vibration, forced vibration, and forced damped vibration, dynamic magnification factor, vibration isolation and transmissibility. **Balancing:** Forces due to revolving masses, balancing of revolving masses in one plane and in different planes.	6
	Total	**42**

List of References:

1. S. S. Rattan, "*Theory of Machines*", Tata McGraw Hill Publication Company Limited, New Delhi.
2. Shigley J.E &UickerJ.J.,"*Theory of Machines and Mechanisms*", McGraw-Hill International Book Co.
3. Wilson, "*Kinematics& Dynamics of Machinery*", 3rd Edition, Pearson Education.
4. Amitabha Ghose and Mallik A K., "*Theory of Mechanism and Machines*",East West Press
5. Rao J S and Dukkipati R V., "*Theory of Mechanism and Machines*", Wiley Eastern Ltd.
6. Dr Jag dishlal, "*Theory of Mechanism and Machines*", Metropolitan Co. Pvt. Limited, New Delhi.
7. Mehta N.K., "*Machine Tool Design*", Tata McGraw Hill.

Course Outcomes:

At the end of this course students will be able to …

1. Analyze the motion of different mechanism and compute velocity and acceleration of any links by using graphical or analytical method.
2. Compute forces acting on different parts of slider crank mechanism.
3. Design the cam profile for specific application.
4. Design flywheel for the requirement of punching and riveting machine.
5. Appreciate the need of balancing and reduction of vibrations in machine tool.

2BS05: NUMERICAL METHODS IN MANUFACTURING
CREDITS - 4 (LTP:3,0,1)
2nd Year, B. Tech. (*Production*)

Course Objective:
To introduce numerical techniques used in analysis of numerous manufacturing processes.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	150
3	0	2	4	60	40	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Numerical Analysis:** **Basics of Numerical Analysis:** Significant figures, Accuracy and Precision, accuracy of numbers, computer representation of numbers **Error Analysis:** Error definitions, Round-off errors and truncation errors in numerical computation, error propagation, total numerical error, blunders, formulation errors, data uncertainty	05
2	**Roots of Non-linear Equations:** Bisection method, False-position method, Secant method, Iteration method, Newton-Raphson method.	08
3	**Solution of Linear Equations & Eigenvalue Problems:** Cramer's rule, Gauss Elimination without and with partial pivoting, pitfalls of Gauss Elimination methods, Gauss-Jordon, LU decomposition, Iterative methods: Jacobi's iteration and Gauss Seidel method, Matrix inversion, Eigenvalues & Eigenvectors, properties of eigenvalues, power method	08
4	**Regression & Interpolation** **Regression:** Least squares regression, Curve fitting, polynomial regression, multiple linear regression **Interpolation:** Newton's Forward interpolation, Backward interpolation and Divided-difference formula, Lagrange interpolating polynomials.	06
5	**Numerical Differentiation & Integration:** **Numerical Differentiation:** Derivatives using Newton's Forward-differences, Backward-differences, Center-differences. **Numerical Integration:** Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Gauss quadrature	06
6	**Numerical Solution of Ordinary Differential Equations:** Initial-Value and Boundary-Value Problems, Single Step and Multi-Step Methods, Picard's method, Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method, Shooting Method.	09

Unit No.	Topics	Teaching Hours
	Total	**42**

List of References:

1. Chapra S. and Canale R., "*Numerical Methods for Engineers*", 6th edition, Tata McGraw-Hill.
2. C.F. Gerald and O.P. Wheatley, "*Applied Numerical Analysis*" 7th edition, Addison Wesley.
3. Sastry S. S., "*Introductory Methods of Numerical Analysis*", 5th edition, Prentice Hall of India.
4. Grewal B. S. "*Numerical Methods in Engineering and Science*", Mercury Learning and information.
5. Jain M. K., Iyengar SRK and Jain R.K., "*Numerical Methods for Scientific & Engineering Computation*",6th Edition, New Age International Publishers.
6. Balagurusamy E., "*Numerical Methods*", Prentice Hall of India.
7. Chapra S. C., "*Applied Numerical Methods with MATLAB*", 3rd edition, Tata McGraw Hill Publishing Co Ltd.
8. Dukkipati R. V., "*Applied Numerical Methods Using MATLAB*", New Age International Publishers.

List of Practical:

Students are required to prepare algorithms on the following topics:

1. Introduction to Matlab for Mathematical methods.
2. Introduction to Numerical & Error Analysis.
3. Program to find roots of non-linear equations using:
   a.Bisection Method. b. False Position Method. c. Newton-Raphson Method.
4. Program to solve linear equations using:
   a.Gauss Elimination Method. b. Gauss-Jordan Method. c. LU Decomposition Method.
   d. Gauss-Seidel Method.
5. Program to implement Power Method.
6. Program to implement Least Squares Method.
7. Program to apply
   a. Newton's forward interpolation formula. b. Lagrange's interpolation formula.
   c. Newton's divided difference formula.
8. Program to find derivatives using forward difference formula.
9. Program to implement Numerical integration:
   a. Trapezoidal Rule b. Simpson's Rule
10. Program to implement a system of ODEs:
    a. Euler's Method b. Modified Euler's Method c. Runge-Kutta Method

Course Outcomes (COs):

At the end of this course students will be able to ……

1. Evaluate errors associated with computation methods.
2. Demonstrate practice of numerical techniques for accurate and efficient solution of models based on linear/nonlinear systems of equations, ordinary differential equations.
3. Formulate numerical models for various manufacturing processes.
4. Apply various numerical models and methods for drawing conclusions and making decisions under uncertainty in Production engineering contexts.
5. Use software tools for implementation and application of numerical methods to visualization of results.

2PE06: FLUID MECHANICS
CREDITS - 4 (LTP:3,0,1)

Course Objective:
To familiarize with fundamentals of Fluid Mechanics

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Topics	Teaching Hours
1	**Introduction :** Fluid,Properties of Fluids: Density, Specific weight, Specific volume, Specific Gravity, Viscosity, Kinematic viscosity, Newton's law of Viscosity, Types of fluids, Surface tension and Capillarity, Vapour pressure and cavitation.	03
2	**Fluid Statics:** Fluid pressure at a point, Pascal's law, Hydrostatic law, Absolute, gauge, atmospheric and vacuum pressure, Measurement of pressure using manometers. Total pressure and Centre of pressure, Hydrostatic forces on horizontally immersed surface, vertically immersed surface and inclined immersed surface. Buoyancy, centre of buoyancy, meta centre, meta centric height, Analytical method for meta centre height, conditions of equilibrium of a floating and submerged bodies. **Fluid Kinematics:** Types of fluid flow,Types of flow lines,Rate of flow, Continuity equation, Velocity and acceleration,Types of motion,Equation of motion for free and forced vortex flow.	12
3	**Fluid Dynamics:** Euler's equation of motion, Bernoulli's equation, Pressure(Static,dynamic and stagnation), Hydraulic grade line and energy grade line, Practical applications of Bernoulli's equation: Venturimeter, Orificemeter, Rotameter, Pitot tube, Flow through an orifice, Determination of hydraulic co-efficient, Discharge over a rectangular notch and triangular notch.	08
4	**Dimensional Analysis:** Dimensions, Dimensional Homogeneity, Methods of Dimensional Analysis, method of selecting repeating variables.	04

Unit No.	Topics	Teaching Hours
5	**Fluid Flow:** Reynolds number, Laminar and Turbulent flow, Reynold's experiment, Flow of viscous fluid through circular pipe (Hagen Poiseuille formula), Flow of viscous fluid between two parallel plates, Methods of determination of co-efficient of viscosity: Capillary tube, Falling sphere method, By rotating cylinder method and Orifice type viscometer, Loss of head due to friction in pipes (Darcy-Weisbach equation).	08
6	**Flow through Pipes:** Loss of energy in pipes, Major energy losses, Minor energy losses, Flow through pipes in series, Equivalent pipe, Flow through parallel pipes.	07
	Total	**42**

List of References:

1. Y. Cengel and J. M. Cimbala, *"Fluid mechanics: fundamentals and applications*", Third edition, McGraw Hill Education.
2. Frank White, "*Fluid mechanics*", Eighth edition, McGraw Hill Education.
3. Fox and McDonald, "*Introduction to fluid mechanics*", Nineth Edition, Wiley.
4. R. K. Bansal, "*Fluid mechanics and hydraulic machines*", Nineth edition, Laxmi publications limited.
5. R. K. Rajput, "*A Textbook of Fluid Mechanics"*, S. Chand Publications.

Course Outcomes:

At the end of this course students will be able to …..

1. Learn basic concepts of fluid mechanics.
2. Apply the knowledge of pressure, statics and kinematics approaches to solve engineering problems in fluid mechanics.
3. Examine energy equations, determine flow rate and velocity using various measuring devices and develop relations using dimensional analysis.
4. Analyze laminar and turbulent flow and experimentally measure viscosity of fluid.
5. Evaluate major and minor energy loss in fluid flow through pipes.

2PE07: CASTING TECHNOLOGY
CREDIT - 3 (LTP:2,0,1)

Course Objective:

To familiarize with fundamentals of casting technology

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)	Credits	Assessment Scheme	Total Marks

L	T	P	C	Theory Marks		Practical Marks		
				ESE	CE	ESE	CE	100
2	0	2	3	30	20	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Casting:** Importance of Casting, Classification of Casting processes. Basic steps in the process of metal casting, application, advantages and disadvantages.	2
2	**Pattern, Mould and Mould making: (to be covered in Practical)** Patterns: materials, types and design of patterns, pattern allowances, pattern colors. Introduction, Moulding sand – types and properties, Moulding tools and equipments- Moulding machines and hand Moulding tools, Function of core, types of cores, core prints, core venting and baking, core shifting and chaplets, Moulding processes- Bench moulding, Floor moulding, Pit moulding, Stack moulding. Green sand moulding, dry sand moulding, loam moulding, core moulding, machine moulding.	2
3	**Foundry Furnaces:** Types of Foundry Furnaces and its selection for various metals - Cupola furnace, Electric arc furnace, Induction furnace, Reverbaratory Furnace.	6
4	**Casting Processes:** Sand casting, Die casting, Investment casting, Centrifugal casting, Shell moulding, Gravity die/permanent mold casting, Continuous casting, Pressure die casting, Slush casting, Non-metal molding/ceramic moulding, squeeze casting.	8
5	**Gating System:** Types of Gates and Risers, Gating ratios and chills, Riser location & design in actual casting, Directional solidification in casting, Physical behavior of metals during solidification, Yield calculation, various fettling and finishing operations of casting. Design and simulation of casting, Fluid and Heat flow analysis.	8
6	**Inspection and Testing of Casting:** Casting defects, Introduction, type of defects, causes and remedies of defects, repairing of defective casting, inspection, destructive and nondestructive testing for casting parts. (To be covered in Practical) **Current trends in Casting technology:** Modernization and Mechanization of foundry, pollution control in foundry.	4
	Total	**28**

List of References:

1. S. Kalpakjian, "*Manufacturing Engineering and Technology*", Pearson.
2. S. Kalpakjian, "*Manufacturing Processes*", Pearson.

3. P Khanna, "*Foundry Technology*", Dhanpat Rai Publication.
4. Ronald A Kohser, "*Degarmon's Materials and Processes in Manufacturing*", Wiley India.
5. Phillip F., Ostwald, Jairo Munoz, "*Manufacturing Processes and Systems*", Wiley India.
6. P.N. Rao, "*Manufacturing Technology*", Vol. II, Tata McGraw Hill.
7. P.C. Sharma, "*Production Technology*", S Chand & Co Ltd.
8. Robert W. Messler, "*Principles of Welding: Process, Physics, Chemistry and Metallurgy*", Wiley Publication.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand concept of casting processes with applications.
2. Work out different processes and its process parameters to obtain qualitative solutions.
3. Design and develop gating system for sound casting.
4. To select and apply knowledge, techniques, skills, and modern tools of the Casting to broadly-defined engineering technology activities and make technical inference about the process.

2HS01: PROFESSIONAL SOFT SKILLS
CREDITS – 2 (LTP:1,0,1)

Course Objectives:

To equip students with Professional soft skills like communication, interviews, group discussion, presentation etc. The subject also will enable them to learn interpersonal skills, work culture and effective management of time and stress. .

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
1	0	2*	2	30	20	20	30	100

***Will be conducted in Class Room**

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Communication skills:** Process of communication, Flows of Communication in organization, Barriers to communication (Formal Flow – Upward, Downward, lateral and diagonal, Strategies to improve Organizational Communication, Effectiveness in Managerial Communication, and importance of technical communication, Non verbal communication	2
2	**Interviews and Meetings**: Types of interview, General preparation for interview, Gathering information about the company, knowing about the role/job position, Types of interviewing questions, Non-verbal communication to win the interview.	2

Unit No.	Topics	Teaching Hours
3	**Meeting and Conferences**: Planning a meeting (Agenda and notice), Conducting a meeting, Post meeting actions (Minutes), Planning & Conducting a Conference (anchoring and Report writing), and Video/web conferences **,**Indentifying Strengths and Weakness	2
4	**Presentation Skills and Letters:** Effective Presentation strategies: Purpose, analyzing the audience and locale, organizing the content Oral presentation, Graphic presentation, Presentation aids, Personality Development. Newsletters, technical article and business letters. Technical Reports, characteristics, Importance, objectives, categories of report, format structure of reports, types of reports	4
5	**Group Discussion**: Qualities needed for effective group discussion. Email etiquettes, Telephone Etiquettes, Role and responsibility of engineer, Work culture in jobs. Work place, rights and responsibilities	3
6	**Time and Stress Management**: Concept & Importance of Time Management, Techniques of Time Management, and Concept & Importance of Stress Management, Techniques of Stress Management, and Overcoming Stage fear and Interpersonal Relationships	2
	Total	**15**

Activities for Practical (Conducted in Class Room)

Sr. No	Activity	Duration (Hours)	Nature of Activity
1	Mock interview	1	Individual
2	Letter Writing	1	Individual
3	Group Discussion	2	Group
4	Group Discussion	2	Group
5	Presentation	2	Individual
6	Presentation	2	Group
7	CV preparation	1	Individual
8	Extempore (over coming stage fear)	1	Individual
9	Aptitude Test	1	Individual
10	Writing skills	1	Individual

List of References:

1. G,S,B,K Babu Rao, "*Business Communication and Soft Skill*", Himalaya Publishing house (1st Edition)
2. Diane Hacker, "*Pocket Style Manual"*, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, "*You Can Win"*, Macmillan Books, New York, 2003.

4. Raman Sharma, "*Technical Communications*", Oxford Publication, London, 2004.
5. *"Ethics in Engineering practice and research" (2nd Edition)* by Caroline Whit beck Cambridge
6. Sharma, R. and Mohan, K. "*Business Correspondence and Report Writing*", TMH New Delhi 2002.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the communication process and communicate professionally.
2. Participate in Group Discussion and evaluate the same.
3. Develop Interview skills and Write Reports
4. Make effective Presentations.
5. Conduct meetings and conferences.
6. Effectively manage time and stress.

3PE01: DESIGN OF MACHINE ELEMENTS
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

To impart principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements as per practices and standards.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Design for Static load and Fluctuating Load** Machine design, Basic procedure of Machine design, Basic requirements of machine elements, Selection of materials based on mechanical properties, Preferred numbers, Types of load and stresses, Modes of failure, Factor of safety, Aesthetic and ergonomic considerations in design, Stress Concentration, Fluctuating stresses, Fatigue failure and Endurance limit, Notch sensitivity, Factors affecting endurance limit, Design for reversed stresses and cumulative damage, Gerber line, Soderberg line and Goodman line, Modified-Goodman diagram, Combined stresses. Design of levers.	08

Unit No.	Topics	Teaching Hours
2	**Design of Fasteners** Design of Riveted Joints: Types of riveted joints, Failures of a riveted joints, Strength and efficiency of a riveted joints, design of riveted joints: longitudinal butt joint and circumferential lap joint, Eccentrically loaded riveted joints. Design of welded Joints: Types of welded joints, design of welded joints for various loading conditions, Eccentrically loaded welded joints. Design of Cotter joints. Design of Knuckle joint.	09
3	**Design of Shafts, Keys and Couplings** Design of solid and hollow shaft subjected to various loading conditions, Design of shaft for rigidity and stiffness Types of keys, design of keys Types of coupling-rigid and flexible, Design of Rigid couplings, Design of Flexible couplings.	06
4	**Design of Clutches** Types of clutches, design of friction clutches **Design of Brakes** Types of brakes, design of single block brake, pivoted block brake, double block, simple band brake, simple band brake, differential band brake, band &block brake and internal expanding brake.	06
5	**Design of spring** Types of springs, terminology of helical spring, design of helical spring, design against fluctuating load, multileaf spring, nipping. **Design of power screw** Types of power screw threads, design of screw with different types of threads used in practice, design of screw jack.	07
6	**Design of Gears** Classification of gears, gear terminology, law of gearing, conjugate action, gear tooth profiles, standard systems of gear tooth, interference and undercutting, backlash, Force analysis of spur gear, gear tooth failures, number of teeth, face width, Beam strength of gear tooth-Lewis equation, Wear strength of gear tooth-Buckingham's equation.	06
	Total	**42**

List of References:

1. V B Bhandari, "*Design of Machine Elements*", Fourth edition, Mc Graw Hill Education
2. Richard Budynas, "*Shingley's Mechanical System Design*", Mc Graw Hill Education
3. V B Bhandari, "*Machine Design Data Book*", Mc Graw Hill
4. Sadhu Singh, "*Design of Machine Elements*", Khanna Publishers
5. P C Sharma & D K Aggarwal, "*Machine Design*", S.K. Kataria & Sons
6. Robert L Norton, "*Machine Design*", Pearson

Course Outcomes (COs):

At the end of this course students will be able to ….

1. Understand the customer need, formulate the problem and design the machine elements subjected to static and fluctuating loads.
2. Design the riveted joints, welded joints, cotter joints and knuckle joints.
3. Design the shafts, keys, couplings, levers, clutches and brakes.
4. Design the spring, power screw.
5. Design the gears based on the given conditions.
6. Use design data books in designing various machine components.

3PE02: WELDING TECHNOLOGY
CREDITS – 3 (LTP: 2,0,1)

Course Objective:

To familiarize with fundamentals of Welding Technology.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Introduction and importance of welding, principle, classification of welding processes as per AWS. Basic steps in the process of welding, application, advantages and disadvantages. Commonly welded base metals, Welding of dissimilar metals, comparison of welding as compared to riveting and casting. Comparison of welding with soldering, brazing and adhesive bonding processes. Weld procedure specification and weld drawing preparation. **	5
2	**Gas Welding Processes:** Introduction, oxy-acetylene welding, oxy-hydrogen, air-acetylene welding. Principle of operation, types of welding flames, Lighting the torch, flame adjustment, gas welding techniques, welding positions, Filler metals and fluxes, gas welding equipments, applications, gas Cutting: Introduction, Principle and application of Gas, Plasma and Laser cutting, kerf-width measurement. **(To be covered in Practical)	5
3	**Arc Welding Processes**: Introduction, principle, welding arc and arc Physics, working, arc initiation and maintenance methods, specifications, equipments, merits and demerits, applications of Carbon arc welding, Flux Shielded Metal	8

Unit No.	Topics	Teaching Hours
	arc welding, Gravity welding, Sub merged arc Welding, Gas tungsten arc welding, Gas metal arc welding, CO_2 welding, Flux cored arc, welding (FCAW), Electro slag welding, Electro gas welding, Plasma arc welding. Power Supply: types AC/DC, their characteristics and its selection. **Arc Welding Electrodes**:** (To be covered in Practical) Types, details, categories of welding electrodes, ingredients of coating and their functions, selection of electrodes, classification and coding of mild steel and low alloy steel electrodes as per Indian and American system.	
4	**Resistance Welding Processes:** Introduction, principle, heat balance, specifications, equipments, merits and demerits, applications of Spot welding, Seam welding, Projection welding, Upset welding, Flash butt welding and Percussion welding. **Solid State and Thermo Chemical Processes:** Introduction, principle, working, specifications, equipments, merits and demerits, applications of Solid state welding processes like Cold (or pressure welding), Diffusion (bonding), Explosive welding, friction welding, Friction stir welding, Inertia and Forged welding, ultrasonic welding. Thermo chemical welding processes like Thermit welding, Atomic hydrogen welding.	6
5	**Inspection and Testing of Welding:** Introduction, type of defects, causes and remedies of defects, repair of defective welded products, weld test-inspection (destructive and nondestructive testing for welding parts). ** (To be covered in Practical) **Current trends in Welding technology:** Hybrid welding, automation in welding.	4
	Total	**28**

List of References:

1. S. Kalpakjian, "*Manufacturing Engineering and Technology*", Pearson.
2. S. Kalpakjian, "*Manufacturing Processes*", Pearson.
3. Ronald A Kohser, "*Degarmon's Materials and Processes in Manufacturing*", Wiley India.
4. Robert W. Messler Jr., "*Principles of Welding: Processes, Physics, Chemistry, and Metallurgy"*, Willey Pulblisher.
5. Phillip F., Ostwald, Jairo Munoz, "*Manufacturing Processes and Systems*", Wiley India.
6. Dr R S Paramar, "*Welding Processes and Technology*", Khanna Publisher.
7. P.N. Rao, "*Manufacturing Technology*", Vol. II, Tata McGraw Hill.
8. P.C. Sharma, "*Production Technology*", S Chand & Co Ltd.
9. Sindo Kou, "*Welding Metallurgy*", Willey Publication.

Course Outcomes (COs): Welding Technology

At the end of this course students will be able to …

1. Analyze the Welding processes for varied engineering applications.
2. Work out different processes and its process parameters to obtain qualitative solutions.
3. Design and develop WPS for welding.
4. To select and apply knowledge, techniques, skills, and modern tools of the Welding Processes.

3PE03: COMPUTER AIDED DESIGN
CREDIT – 4 (LPT: 3,0,1)

Course Objective:
To design and analyze part/system in virtual environment.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Basics of computer aided design, product development life cycle and role of CAD, essential requirements of CAD, concepts on inter-relationship of CAD/CAM, applications CAD systems. Introduction to computer graphics, DDA and Bresenham's algorithms for line & circle.	07
2	**Transformation Techniques and Viewing Operations:** (a) 2D and 3D Transformations: Introduction, translation, rotation, scaling, shearing, reflection, homogeneous representation, concatenated transformation, inverse transformations. (b)Viewing: Windows to view port transformation, clipping.	10
3	**Geometric Modeling:** (a) Curves: Introduction, parametric representation of analytic curves, line, circle, parabola, hyperbola, ellipse, conics, geometric continuity (C0, C1, C2) and visual continuity (G0, G1, G2), synthetic curves, Hermite cubic spline, Bezier curves, B-spline curve, NURBS. (b) Surfaces: Introduction, surface representation, analytic surface, synthetic surface, surface analysis, types of surfaces, Hermite Bicubic surface, Bezier surface, B-spline surface, Coons surface. (c) Solids: Introduction, geometry and topology, solid representation, boundary representation, sweep representation, Boundary representations (B-rep), Constructive Solid Geometry (CSG).	12
4	**3D Modelling and Parametric Relationship**:** Solid modelling of components and assembly using commercial CAD software. Understanding relations, modifying dimensions driven by relations, relation types, specifying a feature and model in a relation, creating parameters, creating relations, understanding family table theory, creating family table.	**

Unit No.	Topics	Teaching Hours
5	**CAD Database:** Evaluation of data exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF, Introduction to product data standards and data structures, CAD integration with CAM.	02
6	**Finite Element Analysis:** Review of stress-strain relation and generalized Hooke's Law, plane stress and plane strain conditions; concept of Total Potential Energy; Basic procedure for solving a problem using Finite Element Analysis. (a) 1-D analysis: Concept of shape function and natural coordinates, strain-displacement matrix, derivation of stiffness matrix for structural problems, properties of stiffness matrix. 1-D structural problems with elimination and penalty approaches, 1-D thermal and fluid problems. (b) Trusses and beams: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members. Structural analysis using Euler-Bernoulli beam element. (c) Higher order element: CST element stiffness matrix formulation, shape functions and applications of quad and axisymmetric elements.	13
	Total	**42**

****** Topics to be covered in laboratory sessions.

List of References:

1. Ibrahim Zied and Sivasubramaniun, "*CAD / CAM: Theory and Practice*", McGraw-Hill Education, Second Edition.
2. P. N. Rao, "*CAD/CAM: Principles and Applications*", McGraw Hill Education, 3E
3. P. Radhakrishnan, S Subramanyam & V Raju "*CAD/CAM/CIM*", New Age International Pvt Ltd, 4E
4. Hearn and Baker, "*Computer Graphics: C Version*", Pearson Education India.
5. David F Roger and J A Adams, "*Mathematical Elements of Computer Graphics*", McGraw Hill Education, Second Edition
6. S S Rao, "*Finite Element Method*"
7. P. Seshu, "*Finite Element Method*", PHI.

Course Outcomes (COs):

After completion of this subject, the students will be able to…

1. Develop skills to construct, edit & plot solid model.
2. Apply algorithms needed for graphical entity generation.
3. Develop skills to understand mathematical aspects of geometrical modelling.
4. Analyze the parts/system through finite element analysis.

3PE04: METAL FORMING PROCESSES
CREDITS – 4 (LTP: 3,0,1)

Course Objective:
This course illustrates the basic concepts of different bulk metal forming and sheet metal forming processes and its applications.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction** Tension, Ductility, True stress, true strain, Types of stress – strain curves, Effects of temperature and strain rate; Compression, Plane strain compression; Bending; Stress state at a point, Triaxial stresses and yield criteria, Maximum shear stress criteria, Distortion energy criteria, Plane stress, Plane strain, Volume strain, Effective stress, Effective strain; Elastic stress-strain relations; Levy-Mises equations of plastic flow; Slip and twinning mechanisms for plastic deformation; Strain hardening; Recovery, recrystallization and grain growth; Cold, warm and hot working; Friction in metal forming, Adhesion theory of friction, lubrication.	12
2	**Rolling** Classification of rolling, Types of rolling mills, Roll pressure distribution, Determining location of neutral point, Front and back tension, Calculating roll forces, Roll torque and power, Friction hill, Defects in rolled products, Rolling related processes: Shape rolling, Ring rolling, Rotary tube piercing, and Thread and gear rolling	8
3	**Forging** Classification, Open-die forging operations, Barreling; Analysis of forging of rectangular workpiece in plane strain; Analysis of forging of solid cylindrical workpiece; Closed-die forging, Impression-die forging, Precision forging, Isothermal forging, Incremental forging, Forging defects; Forging related processes: Roll forging and Rotary swaging	6
4	**Extrusion** Introduction; Types of extrusion (Direct extrusion, Indirect extrusion, Hydrostatic extrusion, Impact extrusion); Ideal force in extrusion; Ideal force in extrusion considering friction; Actual force in extrusion; Optimum die angle; Force in hot extrusion; Extrusion of seamless pipe and tubes; Defects in extrusion.	6

Unit No.	Topics	Teaching Hours
5	**Rod, wire and tube drawing** Introduction; Ideal deformation, Ideal deformation with friction, Die pressure, Drawing at elevated temperature, Optimum die angle, Maximum reduction per pass, Drawing of flat strip, Defects in drawing	4
6	**Sheet Metal Forming Processes** Introduction of sheet metal forming, Formability testing of sheet metals, Determination of Forming Limit Diagrams and their applications, Drawing, Deep drawing and stresses in flange and wall, Limiting drawing ratio, Estimate blank size, Redrawing, Reverse drawing, Ironing, Spinning, Plate, V and edge bending, spring back effect, Curling, Press brake forming, Roll bending, Stretch forming, Coining, embossing, Defects in sheet metal forming processes	6
	Total	**42**

List of References:

1. Juneja B. L., "*Fundamentals of Metal Forming Processes*" 2nd Edition, New age publishers, 2018
2. Srinath L. S., "*Advanced Mechanics of Solids*", 3rd Edition, McGraw Hill Education, 2017
3. Kalpkjian S,"*Manufacturing Processes for Materials*", 6th Edition, Pearson, 2016
4. Kalpkjian S,"*Manufacturing Engineering & Technology*", 7th Edition, Pearson, 2016
5. Dieter G, "*Mechanical Metallurgy*"3rd Edition, McGraw Hill Education, 1986
6. Ghosh A., "*Manufacturing Science*", Pearson India, 2010

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the fundamental concepts of different metal forming processes their engineering applications and limitations.
2. Apply their knowledge to select suitable process, variables, tooling and machines/equipment to make the products from various metal forming processes.
3. Determine the forces and power requirement in different metal forming processes.
4. Investigate defects appeared in the products manufactured by various metal forming processes and determine their causes and remedies.

3CE81: ENVIRONMENT AND HEALTH
CREDITS – 3 (LTP: 3,0,0)

Objective of the Course:

1. To make the students conversant with sources of various pollution.
2. Impart knowledge of health effects of various pollutants.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Content:

Unit No.	Topics	Teaching Hours
1	**Introduction** Scope and importance of Environmental Health, Introduction to Environmental pollution, its impact on human health, epidemiology, agents of diseases and their pathways, chronic and communicable diseases.	07
2	**Air Pollution and Health** Sources of air pollution, Types of air pollutants, impacts on human health, air quality guidelines in protecting public health, global climatic changes and its impact, Indoor air quality, case studies.	11
3	**Water Pollution and Health** Drinking water quality criteria, water borne diseases, aspects of water and wastewater treatment, Fluoride and Arsenic in drinking water in India, case studies.	10
4	**Solid Waste and Hazardous Waste and Health** Sources, classification and composition of MSW, Introduction to MSW management. Definition and classification of hazardous waste, hazard and risk, Health effects of hazardous waste, Resource Conservation and Recovery Act (RCRA) and The Health and Safety at Work Act 1974 (HSWA), case studies.	12
5	**Noise Pollution and Health** Introduction, Sources of Noise, permission noise level and standards, Effects of noise, noise control, case studies.	05
	Total	**45**

List of References:

1. H.S. Peavy, D.R. Rowe and G. Tchbanoglous, "*Environmental Engineering*", McGraw Hill International Edition.
2. G. Tchabanoglous, "*Solid Waste Treatment and Disposal*", McGraw Hill Pub.
3. J.A. Salvato, "Environmental Sanitation", Wiley Interscience.
4. M.L. Davis and D.A. Cornwell, "Introduction to Environmental Engineering", McGraw Hill International edition.
5. Metcalf and Eddy, (Revised by G. Tchobanoglous, Wastewater Engineering: Treatment, disposal and Reuse, Tata-McGraw Hill, New Delhi.
6. J. E. Park, "*Preventive and Social Medicine*", Banarasidas Bhanot Publishers, Jabalpur, 1995.
7. Rao M.N., "*Air Pollution*", Tata McGraw- Hill Publising Company Ltd.,

Course Outcomes (CO_s):

At the end of this course students will be able to

1. Understand assessment procedure of various pollutants of air water and land.
2. Appreciate the effects of various types of pollution on human health

3CE83: EARTH SYSTEM AND GEO-ENVIRONMENT
CREDITS – 3 (LTP: 3,0,0)

Course Objective:

1. Understand and articulate the ways Earth's interior and surface operates, the interconnection of spheres to earth system and linking biogeochemical processes
2. Acknowledge earth resource and cycles of material and energy exchange, dynamic nature of earth and surficial and sub surficial morphological changes on and within the earth
3. Develop understanding of geo-environment, geo-environment divides, Resilience of environmental systems to the global climate and environmental changes and extreme events.
4. Comprehend the advance tool, techniques to monitor, mitigate and manage the geo-environmental challenges
5. Apply the course acquaintance in the respective field of interest.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Earth System:** Earth system Spheres and interaction: Introduction, Scope and fundamentals of Earth System, Understanding Lithosphere (Geosphere), Hydrosphere, Atmosphere, Cryosphere, Biosphere, and dynamics, Anthroposphere influence and impact on earth system. Physical Earth science and Morphology: Natural agencies and Geological work on land surface, Weathering, erosion, surficial and sub surficial water action and associated morphological changes. Earth's Material and Resources: The Rock cycle and rock formation, Various rock types and mineral as resource and soil types and genesis of soil Earth's dynamics: Earthquakes, Seismic activities and plate tectonics, Volcanic bustle and Morphological changes of earth, Relevant case studies	**20**
2	**Geo environment:** Overview of Geo-environment, Geo-environmental divide: Physiographical, geological, hydrological divides and geo-climate. Geo-environmental disasters: Landslides and Mass movement, Tsunami, Desertification, and hydro-meteorological disasters. Anthropogenic influenced Geo environmental problems. Relevant examples and case studies.	**10**

Unit No.	Topics	Teaching Hours
3	**Global geo-environmental Problems and Challenges:** Environmental changes, Global warming, climate changes and pollution related complexities wicked and super wicked problems, understanding geo-environmental impact and challenges in general, Learning through case studies, trending research work and projects at global scale.	**7**
4	**Tool, Techniques and mitigation for disasters and Geo-environmental Problems:** Basic principles and applications of Remote sensing, GIS and GPS, Gadgets and devices for monitoring, predicting time series geo environmental changes; Disasters warning systems for cyclone, Tsunami etc, Disaster management and Mitigation: Software and Modelling approach. Demonstration of working of tools and techniques (Virtual mode).	**8**
	Total	**45**

List of References:

1. Edward A Keller, "*Environmental Geology*", 9th Edition, Pearson, ISBN-13: 978-0321643759, ISBN-10: 0321643755, 2010
2. Edward A Keller, "*Introduction to Environmental Geology*", 5th edition, Pearson, ISBN-10: 9789352864324, ISBN-13: 978-9352864324, 2011
3. Valdiya K S, "*Environmental Geology*", 2nd edition, McGraw Hill, ISBN: 9781259058479, 2013
4. W G Ernst (Editor), "*Earth System: Processes and Issues*", Cambridge University Press, ISBN-10: 0521473233, ISBN-13: 978-0521473231, 2000
5. Steffen, W., Sanderson, R.A., Tyson, P.D., Jäger, J., Matson, P.A., Moore III, B., Oldfield, F., Richardson, K., Schellnhuber, H.J., Turner, B.L., Wasson, R.J, "*Global change and the Earth system: A planet under pressure*", Springer, 2005
6. Andrew DeWet, Kirsten Menking, "*Environmental geology: An Earth system Approach*", 2d edition, W H Freeman, ISBN-10: 1429237430, ISBN-13: 978-1429237437, 2014
7. Sinha, Rajiv, Ravindra, Rasik (Editors), "*Earth system Processes and Disaster management"*, Springer, ISBN 978-3-642-28845-6, 2013
8. Jensen, "*Remote sensing of the environment: An earth resource Perspective*", 2nd edition, Pearson India, ISBN: 9789332518940, 2013
9. Study Report, "*Thriving on our changing Planet",* The National Academic press, ISBN 978-0-309-46757-5, 2018
10. Basudev Bhatta, "*Remote sensing*", Oxford, ISBN: 9780198072393, 2011
11. Prabin Singh, "*Engineering & General Geology*" 8th edition, S K Kataria & sons ,2013

Course Outcomes (COs):

At the end of this course students will be able to …

1. Acquire knowledge of earth system, natural resources, material and energy exchange, dynamics of earth system, linkage of earth system and geo-environmental issues
2. Think critically and discriminate the natural and anthropogenic causatives of geo-environmental disaster, wicked, super-wicked problems and future challenges
3. Associate developed cognizance and perception to accomplish project and research work in a prolific way
4. Employ tool, techniques and software in the respective field to enlarge the future scope and for the career enrichment

3SE81: DISASTER MANAGEMENT AND MITIGATION
CREDITS – 3 (LTP: 3,0,0)

Course Objectives:

1. To impart knowledge of causes of various disaster and its impact
2. To understand the concept of Disaster Management Cycle and Framework
3. To explain the Applications of Science and Technology for Disaster Management & Mitigation

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hrs.
1	**Introduction** Understanding the Concepts and definitions of Disaster and its types, Hazard, Vulnerability, Risk, Capacity, Disaster and Development, and disaster management	4
2	**Consequences and Control of Disasters** Geological, Hydro-Meteorological, Biological, Technological and Man- made Disasters, Global Disaster Trends, Emerging Risks of Disasters, Climate Change and Urban Disasters	8
3	**Disaster Management Cycle and Framework** Disaster Management Cycle, Paradigm Shift in Disaster Management Pre-Disaster Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development, Awareness During Disaster Evacuation, Disaster Communication, Search and Rescue, Emergency Operation Centre, Incident Command System, Relief and Rehabilitation, Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery, Reconstruction and Redevelopment, IDNDR, Yokohama Strategy, Hyogo Framework of Action	12
4	**Disaster Management in India** Disaster Profile of India, Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005, Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management, Role of Government, Non-Government and Inter-Governmental Agencies	11
5	**Applications of Science and Technology for Disaster Management & Mitigation** Geo-informatics in Disaster Management, Disaster Communication System,	10

Unit No.	Topics	Teaching Hrs.
	Land Use Planning and Development Regulations, Structural and Non Structural Mitigation of Disasters, S&T Institutions for Disaster Management in India	
	Total	**45**

List of References:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. Disaster Management Act, Publisher by Govt. of India
5. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
6. NIDM Publications, GoI
7. National Disaster Management Policy, GoI
8. Roy, P.S. (2000): Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA) Dehradun.

Course Outcomes:

After learning the course the students should be able to:

1. Understand disasters, disaster preparedness and apply the mitigation measures
2. Understand role of IT, remote sensing, GIS and GPS in risk reduction
3. Apply knowledge of disaster management acts and guidelines.

List of Open Source Software/learning website:

www.GIS. Development.net
www.iirs.nrsa.org
http://quake.usgs.gov
www.nidmindia.nic.in

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide.

3CP81: FUNDAMENTALS OF COMPUTER NETWORKS AND SECURITY
CREDITS- 3 (LTP: 3,0,0)

Course Objective:

To learn the fundamentals of computer networks and network security concepts.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	-	-	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction** Components, Direction of Data flow, networks, Components and Categories, types of Connections, Topologies, Protocols and Standards, ISO / OSI model, Transmission Media, Coaxial Cable, Fiber Optics, Line Coding Modems	8
2.	**Networks basic** Error, detection and correction, Parity, LRC, CRC, Network Layer, Internetworks, Packet Switching and Datagram approach, IP addressing methods, Subnetting, Routing, Distance Vector Routing, Link State Routing, Routers.	8
3.	**Networking protocols** Functions of transport layer, Multiplexing, De-multiplexing, Sockets, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control, Quality of services (QOS), Integrated Services, Domain Name Space (DNS), SMTP, FTP, HTTP, WWW, Security, Cryptography**.**	10
4	**Security at the application layer** Email architecture, Email Security, PGP-Pretty Good Privacy, PGP Certificates, Trust model in PGP, Key rings, S/MIME-simple multipurpose Internet Mail Extension	7
5	**Security at the transport Layer** SSL Architecture, Key Exchange algorithms, Encryption/ Decryption algorithms, Hash Algorithms, Protocols related to SSL, TLS- Transport layer security, version, cipher suite	6
6	**Security at network layer:** Transport mode, Tunnel mode, comparison, Security protocols, services provide by IPSec, Security Association, Security Policy, Internet Key Exchange	6
	Total	**45**

List of References:

1. Behrouz A forouzan, "*Data Communication and networking*", Mc-Graw hill.
2. Behrouz A forouzan, "*Cryptography and Network Security*".
3. William Stallings, "*Network Security Essentials: Applications and Standards*"

Course Outcomes (COs):

At the end of this course students will be able to…

1. Understand the concepts of Data Communication, Networking and Reference models
2. Understand the concepts of Internetworking Devices and Routing techniques
3. Understand the Application layer protocols like DNS, SMTP, SNMP, FTP, HTTP etc.
4. Understand the concepts of Security at Application layer.
5. Understand the concepts of Security at the Transport Layer.
6. Understand the concepts Security at Network layer.

3CP82: FUNDAMENTALS OF OPERATING SYSTEMS
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

To learn the fundamentals and various functions of operating systems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction** Functions of operating systems, processes, files, command interpreter, Different types of operating systems, operating system interface. Operating system structure: Monolithic, Layered, Hexokernels, Virtual Machines and Client-Server.	05
2	**Processes and their implementation** Process states and state transition diagram, Inter process communication: shared memory and message passing, Race condition, critical sections, mutual exclusion, semaphores and monitors. Threads and thread implementation. Process scheduling: Objectives, First come first serve, shortest job first, Round-robin, Priority-based scheduling and Multilevel feedback queue Scheduling algorithms. Scheduling algorithms of Real Time Operating system.	12
3	**Deadlocks** Definition and simple examples, deadlock detection, recovery, avoidance and Prevention.	04

Unit No.	Topics	Teaching Hours
4	**Memory management** Fixed and variable size partitions, protection of user address space, Swapping, virtual memory systems, demand paging, working set, page replacement strategies, Segmentation.	**09**
5	**File system** Files, Directories and Special files, access methods, Implementing Files and Shared Files, Disk space management and file space allocation methods, file system security, reliability and performance, File-System Backups, File-System Consistency, Reliability and Performance.	**09**
6	**Input and output** Basic concepts, I/O software layers: interrupt handlers, device drivers, and device-independent I/O software. Disk arm scheduling algorithms, clocks, power management.	**06**
	Total	**45**

List of References:

1. Andrew S. Tanenbaum, "*Modern Operating Systems*", Prentice Hall International
2. Silberschatz and Galvin, "*Operating System Concepts*", John Willey and Sons
3. William Stallings,"*Operating Systems*" Prentice Hall of India
4. D.M.Dhamdhere, "*Operating Systems*", Tata McGraw Hill

Course Outcomes (COs):

At the end of this course students will be able to…

1. Understand basic functions of operating system, system call and design structures
2. Explore the process management policies, process synchronization, Dead lock detection and prevention mechanisms used in different operating systems
3. Analyze scheduling algorithms used in general purpose and real time operating systems
4. Compare different memory management schemes and page replacement algorithms.
5. Understand file systems from user and design perspective.
6. Understand role of device driver in I/O management.

3IT81: CYBER SECURITY
CREDITS –3(LTP: 3,0,0)

Course Objective:

To learn importance of securing applications and to make aware about Cyber Security Cyber law, Cyber Crime.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	-	-	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** A brief history of the internet,Application security, Data security, Security technology-Firewall and VPNs, Access control, Security threats, Malicious software, Network and denial of services attack, Electronic payment system, E-Cash, Credit/Debit cards, Digital signature.	5
2	**Cyber Security And Cyber Crime Investigation:** Introduction to cyber security, Introduction to cyberspace, Survey of malware and its existence, Definition of security hole, Security patch, Viruses, Worms, Trojan horses, Social engineering, Avoiding Malwares, Spyware, Keyboard loggers, Ransomware, E-Mail and SPAM, Spoofing, Spammer's tools.	7
3	**Vulnerability Scanning:** Introduction to vulnerability, Vulnerability scanning, Different web vulnerabilities, Open Port and Service Id, Banner disclosure, Traffic probe, Web application testing, Penetration testing.	7
4	**Port Scanning:** Understanding port and services tools, Port scanning tool- Nmap, Netcat, Network sniffers and injection tools, Wireshark.	5
5	**Network Defense Tools:** Firewall basics, Packet filter Vs firewall, How a firewall protects a network, Packet characteristic to filter, Stateless Vs Stateful firewalls, Network address translation (NAT) and port forwarding, The basic of virtual private networks.	6
6	**Web Application Tools:** Scanning for web vulnerabilities tools: Nikto and W3af, Web application testing using DVWA, Manual SQL injection scanning using DVWA, Password Cracking and Brute-Force tools, Wi-Fi passwords cracking WEP & WAP/WAP2 with Aircrack-ng.	8
7	**Introduction to Cyber Crime:** Cyber Crimes, Types of cybercrime, Hacking, Attack vectors, Cyberspace, Traditional problems Associated with Computer Crime, Introduction to incident response, Cybercrime against individual, Cybercrime against property Cybercrime against organization, Cybercrimes against society, Cybercriminals.	7
	Total	**45**

List of References:

1. Mike Shema, *"Anti-Hacker Tool Kit (Indian Edition)"*, Mc Graw Hill.
2. Nina Godbole and Sunit Belpure, *"Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives",*Wiley Publication
3. Dafydd Stuttard and Marcus Pinto, *"The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"*, WileyPublication

Course Outcomes (COs):

At the end of this course students will be able to …

1. Learn the concepts of confidentiality, availability and integrity in Information Security.
2. Explain the concepts cyber-attack, cybercrimes, cyber laws and also how to protect themselves and ultimately society from such attacks.
3. Develop Secure Web Application through vulnerability scanning and understanding the importance of data privacy and protecting data.
4. Distinguish and classify the forms of cybercriminal activity and the technological methods used to undertake such crimes.
5. Investigate assumptions about the behavior and role of victims in cyberspace, and use basic web-tools to explore behavior on-line.
6. Analyze and assess the impact of cybercrime on government, businesses, individuals and society.

3IT82: INTERNET TECHNOLOGY
CREDITS -3 (LTP: 3,0,0)

Course Objective:

To provide knowledge regarding working of Internet, implementation of network with different topologies and server configuration.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	-	-	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction To Internet:** Internet, Growth of internet, Owners of the internet, Anatomy of internet, ARPANET and internet, History of WWW, HTTP protocol, Request and response messages, Methods of HTTP, HTTPS, SMTP, IMAP, POP3 and DNS, Internet applications, Impact of internet on society, Transmission infrastructure, Internet Standards: Standards bodies and the standards process, IETF, ITU, IEEE, ATM forum.	8
2	**Internet Technology, Protocols And Addressing:** Packet switching technology, Internet protocols: TCP/IP, Router, Internet addressing scheme: Machine addressing (IP address), E-mail addresses and Resources addresses.	6

Unit No.	Topics	Teaching Hours
3	**Internet Network:** Network definition, Common terminologies: LAN, WAN, Node, Host, Workstation, Bandwidth, Interoperability, Network administrator, Network security, Network components: Severs, Clients, Communication media, Types of network: Peer to Peer, Clients server, Addressing in internet: DNS, Domain Name and their organization, understanding the internet protocol address, Network topologies: Bust, Star and ring, Ethernet, FDDI, ATM and intranet.	8
4	**Networking Hardware And Software Components:** Network interface cards, Network cables, Network connecting devices, Core Components:Hardware platforms, Internet server components, Web servers, E-mail servers, FTP servers, Proxy servers, News servers, Directory servers, Mirrored servers.	6
5	**Access Methods and Internet Working:** Access Network Architectures: Access Network characteristics. Differences between Access Networks, Local Area Networks and WideArea Networks. Access Technologies: Why there is an upper limit on modem speeds.Voice grade modems, ADSL, Cable Modems, Frame Relay.	5
6	**Internet Application:** FTP, Telnet, Email, Chat. World Wide Web: HTTP protocol.Search Engines. E-Commerce and security issues including symmetric and asymmetrickey, encryption and digital signature, and authentication. Emerging trends, Internettelephony, virtual reality over the web, etc.	6
7	**Internet Security Management Concepts, Information Privacy And Copyright Issues:** Overview of internet security, Firewalls, Internet security, Management concepts and information privacy and copyright issues, Basics of asymmetric cryptosystems.	6
	Total	**45**

List of References:

1. Greenlaw R and Hepp E*, "Fundamentals of Internet and www"*, 2nd EL, Tata McGraw-Hill, 2007.
2. D. Comer, *"The Internet Book",* Pearson Education, 2009.
3. P. J. Deitel, H. M. Deitel, *"Internet and World Wide Web: How to program",* Pearson publication.
4. M. L. Young, *"The Complete reference to Internet",* Tata McGraw Hill, 2007.
5. Douglas E Comer, *"Computer Networks and Internets With Internet Applications",* Pearson.
6. Douglas E Comer, *"Internetworking with TCP / IP, Principles, Protocols & Architecture",*6th Edition, PHI.
7. William Stallings "*Data & Computer Communications*" 8th Edition.
8. A.Farrel IElseviers, "*The Internet and its protocols – A Comparative Approach*" , Morgan Kaufmann Publishers.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the current topics in Web & Internet technologies.

2. Describe the basic concepts for network implementation.
3. Learn the basic working scheme of the Internet and its working.
4. Understand fundamental working of networking hardware and software technology.
5. Understand various internet application and its importance.
6. Identify the various security hazards on the Internet and need of security measures.

3IT83: SOFTWARE PROJECT MANAGEMENT
CREDITS – 3 (LTP: 3,0,0)

Course Objective:
To provide understanding of various stages of software development and quality management process.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	150
3	0	0	3	60	40	-	-	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Project Management:** The management spectrum, The people, The product, The process, The project, Software development life cycle, Typical software roles and responsibilities, Components, Review of models for software development, The W5HH principle.	4
2	**Project Life Cycle And Effort Estimation** Software process and process models, Choice of process models, Rapid application development, Agile methods, Extreme Programming, SCRUM, Managing interactive processes, Basics of software estimation, Effort and Cost estimation techniques, COCOMO II A Parametric productivity model - Staffing Pattern.	8
3	**Activity Planning And Risk Management** Objectives of activity planning, Project schedules, Activities, Sequencing and scheduling, Network planning models, Forward pass & backward pass techniques, Critical path (CRM) method, Risk identification, Assessment monitoring, PERT technique, Monte carlo simulation, Resource allocation, Creation of critical patterns, Cost schedules.	8
4	**Quality Planning:** Quality concepts, Procedural approach to quality Management, Quantitative approaches to quality management, Quantitative quality management planning,	4

Unit No.	Topics	Teaching Hours
	Setting the quality goal, Estimating defects for other stages, Quality process planning, Defect prevention planning.	
5	**Quality Management:** Quality concepts, Software quality assurances, software reviews,formal technical reviews, Formal approaches to SQA, Statistical software qualityassurances, Change Management: software Configuration management, The SCMrepository, SCM Process, Configuration management for web engineering.	4
6	**Project Management in Maintenance of Projects:** Introduction, Software project maintenance life cycle, Process, estimation, Configuration management, Metrics, Defect prevention.	8
7	**Project Execution And Closure:** The review process, Planning, Overview and preparation, Group review meeting, Rework and follow-up, one-person review, Guidelines for reviews in projects, Data collection, Analysis and control guidelines, Introduction of reviews and the NAH syndrome.	6
8	**Software Testing Tools:** Test case generation Methodology, Study of various testing tools.	3
	Total	**45**

List of References:

1. R. S. Pressman, "*Software Engineering*", 7thed ,Tata McGraw Hills.
2. Pankaj Jalote, "*Software project management in practice*", Addison-Wesley.
3. B. Hughes & M. Cotterell, "*Software Project Management*", Tata McGraw Hills.
4. Mantel et al., "*Project Management* – Core text Book", Wiley .
5. Roger S. Pressman, "*Software Engineering*: *A practical Approach*", McGraw-Hill.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand significance of Software development life cycle.
2. Understand steps of software estimation.
3. Analysis of various risk management technique.
4. Reconstruct software using quality management technique.
5. Calculate overall time of software using project execution cycle.
6. Apply software testing tool on real time software.

3IT84: ENTERPRISE RESOURCE PLANNING
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

To understand the business process, project management life cycle and emerging trends of ERP.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	-	-	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**ERP and Related Technologies:** Introduction, Related Technologies, Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Data Warehousing, Data Mining, OLAP, Product life Cycle management, Supply chain management, Customer relationship management, Management information system, Decision support system, Executive information system.	8
2	**ERP Manufacturing Perspective :** MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management.	5
3	**ERP Implementation:** Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks, Requirements Definition, Methodologies, Package selection, Project Teams, Process Definitions, Vendors and Consultants, Data Migration, Project management, Post Implementation Activities.	10
4	**ERP in Action and Business Modules:** Operation and Maintenance, Performance, Maximizing the ERP System. **Business Modules:** Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Quality management, Marketing, Sales, Distribution and service.	10
5	**ERP Case studies and ERP Tools:** E-Commerce to E-business, E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techno enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications. **Introduction to ERP Tools:** JD Edwards-Enterprise One, Microsoft Dynamics-CRM Module.	8
6	**Emerging Trends of ERP:** Extended ERP systems and ERP add-ons, Business analytics, Enterprise architecture planning, ERP usage in Real world, ERP implementation, Future of ERP applications. **Trends in ERP Systems:** Web enabled, wireless technologies, cloud computing.	4
	Total	**45**

List of References:

1. Alexis Leon, *"ERP demystified"*, Third Edition,Tata McGraw-Hill, 2014
2. Alexis Leon, *"Enterprise Resource Planning",* Third Edition,Tata McGraw Hill,2012
3. Ravi Shankar & S. Jaiswal, *"Enterprise Resource Planning"*, Galgotia.
4. Annetta Clewwto and Dane Franklin, *"Guide to Planning ERP Application"*, McGRaw-Hill

Course Outcomes (COs):

At the end of this course students will be able to …

1. Analyze the life cycle of ERP and its related technologies.
2. Identify implementation strategy used for ERP.
3. Explain the performance and maintenance operations of ERP.
4. Examine the working and design principles of various business modules of ERP.
5. Understand the basic tools of ERP.
6. Apply different emerging technologies for implementation of ERP.

3EE81: ENERGY AUDIT & CONSERVATION (O. E.-I)
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

To enhance practical exposure in energy management of industrial utilities such as electrical as well as thermal.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
01	**General Aspects**: Basics of electrical & thermal energy, energy units and conversion. Energy Scenario: Primary & Secondary energy, Commercial & Non-Commercial energy, Nonrenewable & renewable energy, Globally energy reserves and production, Energy conservation and its importance. Energy Conservation Acts: 2001, 2010, Electricity act 2003, National action plan on climate changes, Integrated energy policy, Schemes under EC act 2001. Perform Achieve and Trade (PAT) by BEE in 2008.	05

Unit No.	Topics	Teaching Hours
02	**Energy Management & Audit:** Definition as per EC act-2001, Objective, Need, Types, Benchmarking. Management : Top management commitment & support, Energy policy & planning, Evaluating Energy Performance, Management Tools for Effective Implementation- 5S, KAIZEN, TPM, TQM, ISO 50001, Financial analysis: techniques, Role of ESCOs, project management technique- critical path method, pert analysis. Energy Monitoring & Targeting: Definition, Key elements, CUSUM analysis, Industry 4.0.	07
03	**Renewable Energy Sources:** Concept & Fundamental, Applications: solar-thermal, solar –electrical, wind energy, biomass energy, hydro energy, fuel cell, energy from waste, wave energy, tidal energy, geothermal energy. Global energy Issues: Acid rain, Ozone layer, depletion, global warming & climate change, loss of biodiversity.	05
04	**Energy Efficiency And Performance Of Electrical Utilities:** Electric motor, Air compressed system, HVAC and refrigeration system, Fans & Blowers, Pumps & Pumping System, Cooling towers , Lighting system, DG, ECBC codes. Case study.	10
05	**Energy Efficiency & Performance Of Thermal Utilities:** Boiler, furnace, Insulation & Refractories, Heat exchangers. Case study.	10
06	**Energy Audit Case Study:** Thermal Power Plant, Textile Industry, Ceramic Industry And Cement Industry.	05
	Total	**42**

List of References:

1. General aspects of energy management and energy audit, Guide book EA-EM, BEE, India.
2. Energy efficiency in electrical utilities, Guide book EA-EM, BEE, India.
3. Energy efficiency in thermal utilities, Guide book EA-EM, BEE, India.
4. Energy performance assessment for equipment and utility systems, Guide book EA-EM, BEE, India.
5. Doty, Steven; Turner, Wayne C, Energy Management Handbook (8th Edition), Fairmont Press, Inc., 978-0-88173-707-3
6. Amlan Chakrabarti, Energy Engineering and management, PHI Publication

Course Outcomes (COs):

After learning this course the students will be able to:

1. Understand the recent energy management scenario and nee schemes.
2. Operate and control the industrial process.
3: Identify the utility problems for energy management in different sectors.
4. Solve the industrial energy management and control issues.
5. Solve the problems in different utilities individually.

3EE83: INSTALLATION AND COMMISSIONING OF ELECTRICAL EQUIPMENT
CREDITS - 3 (LTP:3,0,0)

Course Objective:
It is required to carry out/supervise installation, commissioning and maintenance of various electrical equipment in power stations, substations and industry. This course will enable the students to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipment in power stations, substations and industry.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	--	---	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Installation of Electrical Equipment:** Introduction unloading of electrical equipment at site, inspection storage foundation alignment of electrical machines, Tools/Instruments necessary for installation inspection, storage and handling of transformer, switchgear and induction motor preparation of technical report.	04
2	**Commissioning and Testing:** Tests before commissioning of electrical equipment; Electrical and Mechanical test, specific tests on – transformer, induction motor, alternator, need of gradually loading of various machines, tests to be performed after commissioning and before starting the machine, various instruments required for testing, commissioning of switchgear, test report on commissioning and test certificate of electrical equipment, preparations before commissioning of power transformer, commissioning-power transformer, three phase induction motor, transformer insulation oil: properties as per IS, sampling, testing and filtering/purifying, standard tests as per IS, measurement of insulation resistance of different equipment's/machines, methods of Drying the winding of electrical equipment's and its record, classification and measurement of insulation resistance, Polarization Index, appropriate insulation test for specific purpose	08
3	**Maintenance of Electrical Equipments:** General aspect of maintenance, classification, preventive maintenance-concept, classification, advantages, activities, functions of the maintenance department, breakdown maintenance-concept, advantages, activities reasons of failure of electrical equipment due to poor maintenance, factors for preparing maintenance schedule, frequency of maintenance, maintenance schedule of transformer below and above 1000kVA, maintenance schedule - induction motor, circuit breaker, overhead line, storage Battery, probable faults due to poor maintenance in transformer, induction motor, circuit breaker, overhead lines and battery	08

Unit No.	Topics	Teaching Hours
4	**Trouble Shooting:** Causes of fault in electrical equipment's, Internal and external Instruments and tools for trouble shooting, common troubles in electrical equipment – DC Machines, AC Machines, Transformers, Circuit-breaker, underground cable, electrical installation, need of trouble shooting chart, advantages, trouble shooting chart – DC Motor, DC Generator, Transformer, Synchronous Motor, Induction Motor, Circuit-breaker, troubleshooting chart for Domestic appliances- electrical iron, ceiling fan, Washing machine, Air cooler, Vacuum cleaner Fluorescent tube light: Construction, working and troubleshooting chart.	06
5	**Earthing:** Necessity of earthing, system earthing; advantage of neutral earthing of generator in power station, equipment earthing: Objective Types of earth electrodes, Methods of earthing; plate earthing, pipe earthing and coil earthing, Earthing in extra high voltage and underground cable Earthing resistance, factor affecting Determination of maximum permissible resistance of the earthing system, measurement of earth resistance: voltmeter-ammeter method, earth tester method, ohm meter method and earth loop tester method Earthing, grounding and bonding, Comparison between equipment earthing and system grounding Earthing procedure – Building installation, Domestic appliances, Industrial premises Earthing in substation, generating station and overhead line	06
6	**Electrical Accidents and Safety:** Causes of electrical accidents, Factors affecting the severity of electrical shock, Actions to be taken when a person gets attached to live part, Safety regulations and safety measures, Indian electricity supply act 1948- 1956, Factory act 1948, Procedure of shut down for substation and power lines, Permit to work : certificate of (i)requisition for shut down(ii) Permit to work and (iii) Line clear certificate Instruction for the safety of persons working on a job with a permit to work, Fire extinguishers- For fixed installation and portable devices	04
	Total	**36**

List of References:

1. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi
2. Ramesh. L, Chakrasali, "Testing & Commissioning of Electrical Equipment", Prism Books Pvt. Ltd., 2014.
3. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, 2008.
4. Singh Tarlok,"Installation, commissioning and maintenance of Electrical Equipment's. K. Kataria and Sons, New Delhi,
5. Philip Kismet, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGraw-Hill, 2003.
6. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipment/machines.

Course Outcomes (COs):
After learning the course, the students will be able to

1. Installation of Electrical Equipment's
2. Perform commissioning and testing of electrical equipment's
3. Preparation of maintenance schedule of different equipment and machines
4. Trouble shooting chart for various electrical equipment, machines and domestic appliances
5. Procedure of different types of earthling for different types of electrical installations
6. To become familiar about electrical safety regulations and rules during maintenance.

3EL81: ELECTRONICS COMMUNICATION SYSTEM
CREDITS - 3 (LTP: 3,0,0)

Course Objective:
1. To introduce the basic principles and techniques used in Electronic Communications, Digital modulation techniques, Cellular Technology.
2. To introduce fundamental of networking, LAN, Wireless technologies and advance Communication systems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
L	T	P	C	Theory Marks		Practical Marks		Total Marks
				ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1.	**Introduction to Electronic Communication:** The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, The Electromagnetic Spectrum, Bandwidth.	06
2.	**Digital Communication Techniques:** Digital Transmission of Data, Parallel and Serial Transmission, Data Conversion, Pulse Modulation, Digital Signal Processing.	07
3.	**Fundamentals of Networking and LAN and Ethernet:** Network Fundamentals, LAN Hardware, Ethernet LANs, Advanced Ethernet.	06

Unit No.	Topics	Teaching Hours
4.	**Cell Phone Technologies:** Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems , Base Stations and Small Cells.	08
5.	**Wireless Technologies :** Wireless LAN, PANs and Bluetooth, Zigbee, WiMAX and Wireless MetropolitanArea Networks, Infrared Wireless, Ultra wideband, Additional wireless application.	08
6.	**Satellite and Optical Communications:** Satellite orbits, Satellite Communication Systems, Satellite Subsystems, Satellite Applications, Global Navigations Satellite Systems (GNSS), Optical Principals, Optical Communication System, Fiber Optic Cables, and Wave Division Multiplexing Technique.	10
	Total	**45**

List of References:

1. Louis E. Frenzel Jr.,"*Principles of Electronic Communication Systems*", Tata Mc-Graw Hill.
2. Frenzel., "*Communication electronics, principles and applications*", Tata Mc-Graw Hill.
3. George Kennedy, Bernard Davis, SRM Prasanna, "*Electronic Communication Systems*", Tata McGraw-Hill .
4. Behrouz A Forouzan, "*Data Communications and Networking*", Tata Mc-Graw Hill.

Course Outcomes (COs):

At the end of this course students will demonstrate the ability to

1. Understand the basic concept Communication system.
2. Apply network fundamentals for LAN and Ethernet.
3. Analyze Cellular Technologies.
4. Analyze advance communication systems.

3EC81: INTRODUCTION TO CELLULAR COMMUNICATION
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

To understand the concept of mobile communication, frequency reuse, wireless model, GSM & CDMA network, various wireless protocols & its applications related to mobile communication.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1.	**Evolution of Mobile Communication Systems :** Introduction-base station, mobile station, MSC, forward and reverse channel, control channel, Paging system, Cordless telephone system, Cellular telephone system, Advantages and disadvantages of mobile communications, Comparison of wireless systems, applications of wireless communications.	04
2.	**Cellular Concept – System Design Fundamentals :** Introduction, frequency reuse, channel assignment strategies, handoff strategies, umbrella cell concept, interference and system capacity, co-channel and adjacent channel interference, cell splitting, sectoring, microcell zone concept.	06
3.	**Mobile Communication Engineering :** Introduction, Radio paths, Propagation attenuation, Basic propagation mechanisms, mobile radio channel, simulation of wireless fading channels, free space propagation model, outdoor propagation model.	08
4.	**GSM & CDMA Systems :** GSM network architecture, GSM signaling protocol architecture, Identifier used in GSM systems, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM handoff procedures, GSM services and features, Concept of spread spectrum, CDMA architecture.	12
5.	**3G and 4G Digital Mobile Technology :** 2.5G TDMA evolution path, GPRS technology, EDGE technology, 2.5G CDMA technology, Need of 3G and 4G mobile networks, IMT-2000 Global standards, UMTS technology, W-CDMA air interface, TD-SCDMA technology, CDMA 2000 technology. 4G-LTE.	09
6.	**Emerging Wireless Network Technologies :** IEEE 802.11 WLAN technology, IEEE 802.15 WPAN technology, IEEE 802.16 WMAN technology, Mobile adhoc networks (MANETs), Wireless sensor networks, RFID technology, IEEE 802.21 standards overview, Case studies of latest wireless technologies.	06
	Total	**45**

List of References:

1. T. L. Singal, *"Wireless Communications"*, Tata McGraw Hill , 2nd Edition, 2011.
2. T. S. Rappaport, *"Wireless Communications: Principles and practice"*, Pearson, 2nd Edition,

2010.
3. A. Goldsmith, "*Wireless Communications*", Cambridge university press, 1st Edition, 2005.
4. B. Razavi, "*RF Microelectronics",* Prentice Hall, 1st Edition, 1998.
5. W.C.Y. Lee, *"Mobile Communications Engineering"*, McGraw Hill Telecomm., 2nd Edition, 1998.

Course Outcomes (COs) :

By learning this course students will be able to …
1. Understand the basics of mobile communication systems.
2. Design the cellular system and improve the coverage and capacity of system.
3. Analyze and design the various mobile propagation model.
4. Design GSM and CDMA wireless networks.
5. Study the 3G and 4G digital mobile technology.
6. Compare the recent emerging protocol of wireless communication system.

3EC82: APPLIED ELECTRONICS
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

The basics of applications based electronics fundamentals are covered for the students of different braches other than electronics and communication.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Content:

Unit No.	Topics	Teaching Hours
1.	**Operational Amplifiers :** Ideal operational amplifier, Operational amplifier Stages, Operational amplifier parameters, Equivalent circuit of op-amp, Ideal Voltage transfer Curve, Open-Loop Op-amp configurations, Closed-Loop op-amp configurations	06
2.	**555 Timer Circuits** : Block diagram, Use as Astable multivibrator and monostable multivibrator	04
3.	**Transducers :** Capacitive Transducer, Inductive Transducer, Linear Variable Differential Transformer, Oscillation Transducer, Potentiometric transducer, Electrical strain gauges, Resistance thermometer, Thermistor, Thermocouple, Piezoelectric Transducer, Photoelectric transducer	07

Unit No.	Topics	Teaching Hours
4.	**Introduction to Electronics Communication :** The significance of Human Communication, Communication systems, Types of Electronics Communication, Modulation and Multiplexing, The electromagnetic Spectrum, Bandwidth	06
5.	**Optoelectronic Devices :** Photoconductive sensors, Photovoltaic sensors, Photo emissive sensors, Light emitters, Liquid Crystal Display, Opto-coupler	07
6.	**Memories and Microcontroller :** Introduction to semiconductor memories, The AVR microcontrollers' history and features, AVR architecture ,AVR programming in C.	07
7.	**Consumer Electronics :** Washing machines (Electronic Controller, Fuzzy logic machines and automatic washing Machines), Audio systems, I-pods, RFID, Barcode Scanner and decoder, Photocopier machines, Introduction to organic electronics and internet of things (Industry 4.0)	08
	Total	**45**

List of References:

1. S Salivahanans, N Kumar, A Vallavaraj, "*Electronic devices and circuits*",2nd Edition, McGraw Hill,2008
2. Santiram KAL, "*Basic Electronics Devices, Circuits and its Fundamentals*",5th Edition, PHI Publication,2006
3. M.A. Mazidi,Sarmad Naimi,Sepehr Naimi, "*The AVR Microcontroller & Embedded Systems using Assembly and C*",1st Edition, Pearson Education,2011.
4. Louis E. Frenzel, "*Principles of Electonic Communication Systems*",3rd Edition, McGraw Hill Publication,2014
5. Alasdair Gilchrist, " *Industry 4.0* ", Apress, 2016

Course Outcomes (COs):

1. Understand the fundamental s of Operational amplifier and its applications.
2. Analyze and able to design sensor based applications.
3. Understand the Principles of Electronics Communication.
4. Understand and able to analyze Modern Communication systems and its applications.
5. Able to use of the CAD tools and programming of AVR on C platform.
6. Design and understands the various modern electronics based real time industrial applications.

3PE41: RELIABILITY, MAINTENANCE & SAFETY ENGINEERING
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

To understand and implement maintenance strategies, schedule and principles, to achieve better maintainability, reliability, and availability of equipment, systems, machineries and infrastructure. To also focuses on various safety engineering aspects like understanding hazards, quantifying risk, design for Safety, investigating accident, safety education and training.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	**CONCEPTS OF RELIABILITY:** Introduction, Need, Basic Elements of Reliability, Measurement of Reliability, Cost of Reliability, Maintenance & Reliability, Maintainability, MTBF, MTTR, Maintenance action Rate, Failure Mode Effect & Criticality Analysis (FMECA), Hazard Analysis, System Reliability- Series, Parallel and Mix Problem.	15
2	**MAINTENANCE ENGINEERING:** Introduction, Maintenance Objectives, Maintenance cost, Benefits and Limitations of failure statistics, Types of Maintenance, Preventive Maintenance system, Preventive versus Breakdown Maintenance, Maintainability and availability, Condition based maintenance system, Basic Maintenance decisions, Maintenance performance measurement.	15
3	**INDUSTRIAL SAFETY AND SAFETY ACTS:** Introduction to the development of industrial safety and management**,** Accident preventions, protective equipment's and the Acts, Safety Acts, safety and maintainability design, Tools for safety analysis. Safety audit and planning for safety.	12
	Total	**42**

List of References:

1. E Balaguruswamy, "*Reliability Engineering*", Tata McGraw Hill
2. L. S Srinath, "*Reliability Engineering*", East-West Press
3. Srivastava, S.K., "*Maintenance Engineering*", S. Chand and Co.
4. Bhattacharya, S.N., "*Installation, Servicing and Maintenance*", S. Chand and Co.
5. Dr A K Gupta, "*Reliability, Maintenance and Safety Engineering*", University Science Press.
6. Willie Hammer, "*Occupational Safety Management and Engineering*", Prentice Hall.
7. White, E.N., "*Maintenance Planning*", Documentation, Gower Press.
8. Garg, M.R., "*Industrial Maintenance*", S. Chand and Co.
9. Higgins, L.R., "*Maintenance Engineering Hand Book*", 5th Edition, McGraw Hill.
10. Armstrong, "*Condition Monitoring*", BSIRSA.
11. Davies, "*Handbook of Condition Monitoring*", Chapman and Hall.
12. Ray Asfahl, C., "*Industrial Safety and Health Management*", 5th Edition, Prentice Hall.
13. S.C.Mishra, "*Reliability and Maintenance Engineering*", New Age Publishing house

Course Outcomes (COs):

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

1. Understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
2. Understand the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
3. Understand safety engineering aspects in industry.

3PE42: PROJECT MANAGEMENT
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

To provides a systematic and thorough introduction to all the aspects of project management.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Project Management:** Definition of Project, Program and Portfolio, Project Management, Project Management and General Management, Project parameters: Scope, Quality, Cost, Time, Resources, The scope triangle: Time, Cost, and Resource Availability, The Life cycles of Projects, Project Classifications, Principles of Project Management: Defining, Planning, Executing, Controlling, Closing. Phases of Project Management: Scope the Project, Develop the project plan, Launch the plan, Monitor/control project progress, Close out the Project.	06
2	**Organizing the Project and Scope of the Project:** The PM's Roles, The PM's responsibility to the project, Selection of a project Manager, and The Project team. Developing Conditions of Satisfaction, Establishing Clarity of Purpose, Creating the Project Overview Statement, Parts of the POS, Attachments Submitting a Project for Approval, Submitting a project for Approval, Participants in the Approval Process, The Project Definition Statement.	07

Unit No.	Topics	Teaching Hours
3	**Planning the Project and Budgeting the Project:** The contents of a Project Plan, The Planning Process- Overview, The Planning Process- Nuts and Bolts, The project action plan, The Work breakdown Structure, Use for the WBS, Generating the WBS, Six criteria to test for completeness in the WBS, Approaches to Building the WBS, Representing the WBS. Methods of Budgeting: Top-Down Budgeting, Bottom-Up Budgeting, Cost Estimating, Improving Cost Estimates, Budget Uncertainty and Risk Management.	07
4	**Scheduling the Project- Network Analysis-PERT:** **Elements of network:** Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, Graphical guidelines for network, Common partial situations in network, numbering the events, cycles. **Developing the Network:** Planning for network construction, modes of network construction, steps in developing network, hierarchies. **Time Estimates in PERT:** Uncertainties and use of PERT, Time estimates, Frequency distribution, Mean, Variance & standard deviation, Probability distribution, Beta distribution, Expected time. **Time Computations:** Earliest expected time, Formulation for T_E, Latest allowable occurrence time, Formulation for T_L, Combined tabular computations for T_E, T_L. **Network Analysis**: Slack, Critical Path and Probability of meeting schedule date.	08
5	**Scheduling the Project- Network Analysis-CPM and Allocating the Resources to the Project:** **Network Analysis** :Introduction to Critical Path Method, CPM- Process, CPM - networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for T_E and T_L, Start & Finish times of activity, Float, Critical activities & Critical path. **Cost Model**: Introduction, Project cost, Indirect project cost, Direct Project cost, Crashing of project network. Introduction, Resources Usage Profiles: Histograms, Resources Smoothing, Resources Levelling.	08
6	**Monitoring and Controlling the Project and Closing out the Project:** Control versus Risk, Purpose of Controls, Control versus Quality, Progress reporting System, Applying Graphical Reporting Tools: Cost Schedule control, Deciding on Report Level of Detail, Managing project Status meetings, Managing Change, Managing Problem Escalation.	06

Unit No.	Topics	Teaching Hours
	Steps in Closing a project, Getting client Acceptance, Installing Project Deliverables, Documenting the Project, Post Implementation Audit, The Final Report.	
	Total	**42**

List of References:

1. Robert K. Wysocki, Robert Beck. Jr., and David B.Crane , "*Effective Project Management* ", Wiley India.
2. Samuel Mantel, Jack Meredith, Scott Shafer, Margaret Sutton , M. R. Gopalan, "*Project Management Core Textbook*", Wiley India.
3. Harold Kerzner, "*Project Management: A Systems Approach to Planning, Scheduling and Controlling*", Wiley India
4. Dr. B.C. Punamia & K.K.Khandelwal , "*Project Planning and Control with CPM and PERT*", Laxmi Publications, New Delhi.

Course Outcomes (COs):

After completion of this subject, the students will be able to…

1. Understand about Project, Project management and role of project manager.
2. Define& develop project statement & project plan.
3. Develop & analyze project network diagram with cost model.
4. Estimate project budget and resource allocation.
5. Monitor, control and close out the Project.

3PE43: MECHATRONICS
CREDITS - 4 (LTP: 3, 0, 2)

Course Objective:

Mechatronics is a rapidly growing interdisciplinary field of engineering with synergistic integration of mechanical engineering, electronics engineering, computer technology & control engineering in development of electromechanical products through a unified design approach. Students with sound & fundamental knowledge and understanding of this broad & multi-disciplinary course are today's need of industries. The basic objective of this course is to prepare the students of Production Engineering Program to fulfill the said need.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Mechatronics Systems:** Introduction to mechatronics, Elements of Mechatronics System, Mechatronics Design Process, Measurement & Control Systems, Real-time Mechatronics Systems & Other Applications	05
2	**Sensors & Transducers:** Introduction, Types of Transducers, Characteristic Parameters used in Transducers, Working Principles of sensors used for Displacement, Position, Proximity, Velocity, Motion, Force, Acceleration, Torque, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, and Light Measurements/Sensing.	11
3	**Analog Signal Conditioning:** Signal conditioners, Operational amplifiers, Noise Reduction, Bridge Circuits.	05
4	**Actuators in Mechatronics:** Introduction, Working, construction & applications of hydraulic, pneumatic, mechanical and electrical actuators, Selection Criteria for actuators.	08
5	**Digital Electronics & Systems:** Digital Logic Control including Logic Gates, Boolean Expression from Truth Table, Applications of Logic Gates, Sequential Logic, Microprocessors & Microcontrollers including their structures, applications & basic programming, Data Acquisition Systems, Input/Output Hardware, Analog-to-Digital & Digital-to-Analog Conversions	06
6	**Programmable Logic Controllers:** Introduction, Basic Structure of a Programmable Logic Controller (PLC), Principles of Operation, Internal Architecture & Hardware Components, PLC Programming & Use of Ladder Diagrams, Applications of PLCs for Control, Case Studies of Mechatronics System's Design.	07
	Total	**42**

List of References:

1. K. P. Ramchandran, G. K. Vijayaragravan & M. S. Balasundram, "*Mechatronics: Integrated Mechanical Electronic Systems*", Wiley India Pvt. Ltd., 2008.
2. W. Bolton, "*Mechatronics*", Pearson Education (India), 2003.
3. Histand B.H. & Alciatore D.G., "*Introduction to Mechatronics and Measurement Systems*", Tata McGraw Hill Publishing Company Ltd, 3rd Edition, 2007.
4. Shetty D., Kolk R. A., "*Mechatronic System Design*", PWS Publicity Boston, 2002.
5. R.K. Rajput, "*A Text Book of Mechatronics*", S. Chand & Company Ltd., 1st Edition, 2007.
6. Sabri Cetinkunt, "*Mechatronics with Experiments*", John Wiley & Sons Ltd,This edition first published 2015.
7. Godfrey C. Onwubolu, "*Mechatronics Principles and Applications*", Elsevier Butterworth-Heinemann, First published 2005.
8. R. S. Gaokar, "*Microprocessor Architecture, Programming and Applications with the 808*", Penram International Publishing, 5/e.
9. Edited by Clarence W. de Silva, Farbod Khoshnoud, Maoqing Li & Saman K.

Halgamuge,"*Mechatronics - Fundamentals and Applications*", CRC Press - Taylor & Francis Group, 2016.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand & explain key elements of mechatronics system, core technology necessary for the design & development of the mechatronics products as well as provide examples of mechatronics systems.
2. Learn about performance parameters of sensors & transducers used in the measurements of various parameters & quantities as well as understand construction, working & selection criteria of various types of sensors & transducers.
3. Explain the purpose & importance of signal conditioning, the use of operational amplifiers, and noise reduction & filtering.
4. Understand working, construction & applications of hydraulic, pneumatic, mechanical and electrical actuators.
5. Understand the fundamentals of digital logic control, logic gates, microprocessors, microcontrollers & data acquisition systems including interfacing requirements, analog-to-digital & digital-to analog conversions, and design simple logic circuits.
6. Explain the operations of hardware & input/output devices found in programmable logic controllers, and develop PLC programming using ladder diagram as well as understand case studies related to various mechatronics systems.

3PE05: COMPUTER AIDED MANUFACTURING
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

With an increase in the need for quality manufacturing along with the factors of short lead time & short product lives and increasing consumer awareness regarding the quality of the product, it is becoming increasingly important for the manufacturer to initiate steps to achieve all these. With the advent of microelectronics, the students of manufacturing discipline must take advantage of the availability of low-cost & more powerful computers operating machines in industries for manufacturing, planning, control & other functions.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Computer Aided Manufacturing:** Computers in industrial manufacturing, Product cycle & CAD/CAM,	04

Unit No.	Topics	Teaching Hours
	Automation & CAD/CAM, Benefits & limitations of using CAM technology, Applications of CAM in industries.	
2	**Introduction to NC/CNC Machine Tools:** Introduction, Difference between NC & conventional machine tools, Advantages of CNC over NC, Advantages of NC/ CNC over conventional machine tools, Limitations of NC/CNC machine tools, Specifications of typical CNC machine tools. Basics of NC/CNC machine tools, Axes designation, Coordinate system, Reference points- Grid system, Machine origin, Part origin & Tool reference point. Classifications NC/CNC machine tools on the basis of number of axes, control systems (P, L & C type controls), power supply used, Automatic tool changer (ATC) & Automatic pallet changer (APC). CNC machine tools – Structure including Spindle, Bearings, Guideways, Transmission system, Recirculating ballscrews, Roller screw, Drives including Stepper motor, AC/DC Rotary servo motor, Linear motor, Open loop & Closed loop control systems, Tool presetters.	09
3	**Part Programming:** Basics of programming, Coding systems, Types of codes, G- & M-codes, Absolute & Incremental programming, Diameter & Radius programming, Programming functions, Spindle speed control, Tool & tool offset, Tool compensations, Programming on Turning center & Machining center for turning, threading, drilling, tapping & profile milling operations, Use of Canned cycles &Subprogramming features.	16
4	**Computer Aided Process Planning (CAPP):** Introduction, approaches to CAPP- Retrieval/variant system & Generative system, Implementation techniques – decision tables, expert system technique (AI), Concepts of Material Requirement Planning (MRP-I) & Manufacturing Resource Planning (MRP-II), Concept of Finite Requirement Planning (FRP).	05
5	**Introduction to Robotics:** Introduction & definition, Characteristics of a true robot, Laws of robotics, Robot anatomy & Manipulator, Types of joints, degree of freedom of robot, Work envelope – work volume, Robot configurations, Comparison of configurations, Basic robot elements – controller, manipulator, end effectors, sensors & actuators, Performance specifications of robot.	06
6	**Computer Integrated Manufacturing:** Concept of Computer Integrated Manufacturing (CIM), Modules of CIM, CIM wheel to understand basic functions, Benefits of CIM.	02
	Total	**42**

List of References:

1. Mikell P Groover, *"Automation, Production Systems and Computer Integrated Manufacturing"*, Pearson Education Inc.
2. Mikell P Groover & E. W. Zimmer, *"CAD/CAM, Computer Aided Design & Manufacturing"*, Pearson Education Inc.
3. P M Agrawal & V J Patel, *"CNC Fundamentals and Programming"*, Charotar Publishing House Pvt. Ltd., 2nd Revised Edition, 2014.
4. P N Rao *"CAD/CAM***:** *Principles and Applications"*, Tata McGraw Hill Education Pvt. Ltd., Delhi, 2010.
5. P. N. Rao, N. K. Tewari& T. K. Kundra, *"Computer Aided Manufacturing",* Tata McGraw Hill Education Pvt. Ltd., Delhi, 2010.
6. Tien Chien Chang, Richard A. Wysk & Hsu-Pin Wang, "*Computer Aided Manufacturing*", Pearson Education Inc.
7. Ibrahim Zeid, *"CAD/CAM Introduction",* Tata McGraw Hill Education Pvt. Ltd., Delhi, 2007.
8. Er. J S Narang, Er. Sanjeev Walia & Er. V. D. S. Narang, *"Computer Aided Manufacturing (CNC & Robotics)",*Dhanpat Rai & Co. (P) Ltd., 2010.
9. S K Saha, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd., 4th Ed. 2011.
10. P. Radhakrishnan, *"CAD/CAM/CIM",* New Age International Publication.
11. Manua Singh, *"System Approach to Computer Integrated Manufacturing"*, Wiley and Sons Inc, 1996.
12. S R Deb & S Deb, *"Robotics Technology and Flexible Automation"*, McGraw Hill Education Pvt. Ltd.
13. Y. Koren, *"Robotics for Engineer"*, McGraw Hill Education Pvt. Ltd.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the various spheres of manufacturing activities where computers are used, the meaning of product cycle with difference between conventional & computer-based manufacturing and identify various computer-based applications in manufacturing.
2. Understand the principle of NC and CNC technologies, their components, advantages & disadvantages along with the hardware requirements & control systems for NC/CNC machine tools.
3. Create & simulate sample part programs using fundamentals of part programming for CNC turning & machining centers using word address format, canned cycles & sub-programming involving use of G- & M-codes for turning, threading, drilling, tapping & profile milling operations.
4. Understand importance & needs of computer aided process planning (CAPP), different approaches used in CAPP, and learn about the concepts of material requirement planning (MRP-I), manufacturing resource planning (MRP-II) & finite requirement planning (FRP).
5. Learn & understand concept of robotic, impact on society, use of robots including their components (grippers, sensors, actuators) & various robot-configurations as well as robot performance specifications required for applications.
6. Understand concept of computer integrated manufacturing with modules, functions of each module & benefits of CIM.

3PE06: TOOL ENGINEERING
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

This course illustrates the basic aspects of tooling, tool design and methods used in various metal cutting and forming processes.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Cutting Tools Design** Types of cutting tools, Design of single point cutting tools, milling cutters, drills, reamer, broach, cutting tool materials and heat treatment, manufacturing of cutting tools, coating on tool, Tool holders for turning and milling, tool inserts-types, ISO-designation and applications, Tool Reconditioning	6
2	**Jig and Fixtures** Concept of location and clamping, 3-2-1 principle of location, Location system for standard work and tool holding devices, locating and clamping methods, analysis of clamping force required, general guideline for design of jig and fixtures, fool proofing and ejecting, various elements of jigs and fixture, drill jig, fixtures for milling, lathe, grinding and welding processes, economics of jig and fixtures, concept of modular fixture and tool presetting.	8
3	**Press Tool Design** Press operations, Press working equipment, press selection, types of dies, principle of sheet metal cutting, stages of cutting operation, center of pressure, strap strip layout, cutting force and press tonnage, methods to reducing cutting force, design and manufacturing of blanking die, piercing die, deep drawing die, bending die	10
4	**Forging die design** Forging equipment and selection, impression in multiple impression die, design and manufacturing of forging dies, Guidelines for selection of various design factors, parting line, draft, rib-web, Corner & fillet radius, shrinkage & die wear etc., Determination of stock size.	6

Unit No.	Topics	Teaching Hours
5	**Die-casting dies design** Die Casting processes Hot & Cold Chamber, Metals for die casting, Design considerations in die casting. Types of cores, feeders, inserts, die lubrications & rules, heat transfer consideration, directional solidification, cooling system, feed and flow system and ejection system, interlocks & safety devices, die casting defects and remedies.	6
6	**Plastic Moulding** Introduction of compression and transfer moulding process, Study of Injection and blow moulding process; - machine specifications, moulding cycle. Design of simple two plate injection moulds. Design of simple blow moulds for articles, Study of types of ejectors, gates, runner's, Study of cooling systems and heat transfer consideration. Calculation of no. of cavities, Mould opening force, ejection force etc.	6
	Total	**42**

List of References:

1. Donaldson C., *"Tool design",* 4th edition, McGraw Hill Education, 2012
2. Eary D. F., Jhonson G. E., *"Process Engineering for Manufacturing",* Prentice-Hall, 1962
3. Basu S., Mukherjee S., Mishra R., *"Fundamental of Tool Engineering Design",* Oxford & IBH Publishing Co. Pvt. Ltd., 1979
4. Sharma P., *"A textbook of Production Engineering",* S. Chand & company Pvt. Ltd., 2015
5. Nagpal G., *"Tool Engineering & Design",* Khanna Publication
6. Grant H., *"Jig and fixtures non-standard Clamping Devices",* McGraw Hill Education, 1971
7. Joshi P., *"Jigs and fixtures",* 3rd edition, McGraw Hill Education, 2017
8. *Handbook of Die design Handbook, McGraw Hill, 2006*
9. *Metal Hand Book, Vol-II and III.ASME*
10. *Forging Handbook, ASM, Vol. 5, 9th edition*

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the fundamental concept of design of various tooling used in the manufacturing processes.
2. Design and manufacturing of single point and multipoint cutting tools.
3. Apply concept of location theory for the design of jigs and fixtures.
4. Design the dies used in the press working, forging, die-casting and plastic molding processes for simple shape components.

3HS01: ETHICS AND CONSTITUTION OF INDIA[#]
CREDITS – 0 (LTP : 2,0,0)

Course Objective:

To create awareness of Engineering Ethics and human values, instill moral social values, loyalty and ethical issues. It will allow the students to assimilate with basic information about Indian Constitution, know its salient features and thus functioning of Democracy in India

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	0	0	30	20	00	00	50

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Professional Ethics:** Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift v/s Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures.	7
2	**Engineering ethics:** Definition-Approach-Senses of Engineering Ethics-variety of moral issues– Definition–Ethical theories-Theories about right action Personality– Self-control-Self-interest –Self-respect.	7
3	**Constitution and Constitutionalism**: Historic perspective of constitution of India, Salient features and Characteristics of constitution of India, Scheme of fundamental rights, Scheme of fundamental duties and its legal status, The directive principles of State policy-its importance and implementation	7
4	**Federal Structure:** Distribution of legislative and financial powers between the union and states, Parliamentary form of government in India, The constitution powers and status of the President of India, Amendment of Constitution powers and procedure. Functions of state legislature, Structure of state executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister.	7
	Total	**28**

List of References:

1. Govindrajan.M, Natrajan S, Senthilkumar V.S, "*Engineering Ethics(Including Human Values)",* PHI publication, latest edition.
2. Reddy.N H, Ajmera, Santosh, "*Ethics, Integrity and Aptitude*", Tata McGraw Hill.
3. Durga Das Basu (DD Basu): *"Introduction to the Constitution on India*", (Students Edition.) Prentice –Hall EEE, 19th / 20th Ed., (Latest Edition) or 2008.
4. Shubham Singles, Charles E. Haries, and Et al: "*Constitution of India and Professional Ethics*" by Cengage Learning India Private Limited, Latest Edition – 2018.
5. M.V.Pylee, "*An Introduction to Constitution of India*", Vikas Publishing, 2002.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Practice the moral values that ought to guide the engineering profession.
2. Discover the set of justified moral principles and apply them to concrete situation.
3. Appreciate the ethical issues and know the code of ethics in different professional bodies.
4. Discover the Federal structure and Constitution of India.
5. Know the successful functioning of democracy in India.
6. Apply the statutes available in the Constitution to the field of engineering.

3CE82: GEOINFORMATICS
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

1. Learn basics of optical remote sensing for mapping the earth surface.
2. Understand thematic mapping using GIS.
3. Study to map location of various objects on the surface of earth.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Remote sensing systems, multi concept of remote sensing, Remote sensing in India, GIS: Basic Concepts, Basic concept of Positioning and Mapping, Positioning Using Satellites, Concept of Regional and Global Navigation Satellite System.	05
2	**Electromagnetic radiation:** Introduction: EM radiation, EM Spectrum and Wavelength useful for remote sensing, Energy interaction in the atmosphere, Energy interaction with earth surface feature, Resolution: Spatial, Spectral, Radiometric and Temporal.	05
3	**Sensors and platforms:** Classification: Land observation satellites, high resolution sensors, and Satellite data products: Introduction, data reception, transmission and processing of Remote sensing data products and Digital data products.	05
4	**Image interpretation & Digital image processing:** Procedure and elements of visual interpretation, interpretation keys. Overview of digital analysis steps, Image atmospheric correction, Image geo-referencing and resampling. Image contrast enhancement, Image filtering: Low-pass and	10

Unit No.	Topics	Teaching Hours
	High-pass filters, Image transformation: PCT, Supervised Classification, Unsupervised Classification and Accuracy Assessment.	
5	**Geographical Information System (GIS):** Definitions, Key Components and Functions of GIS, Spatial data and its structures, Attribute data for GIS, Geospatial Analysis: Spatial interpolation, Surface analysis, Network analysis and Integration of Remote Sensing and GIS.	10
6	**Global Navigation Satellite System (GNSS):** Global Positioning System (GPS-United States): Introduction and Three Segments of GPS, GPS Positioning Techniques, Surveying Using GPS and Mapping Using GPS. Introduction to GLONASS (Russia), Galelio (European Union), BeiDuo (China) and IRNSS (India).	05
7	**Applications of Geoinformatics in Utility Management** Applications in Utility management of Electricity, Gas sector, Telecommunication, Water supply and waste water collection utility sector.	05
	Total	**45**

List of References:

1. Bhatta B., "*Remote Sensing and GIS*", Oxford University Press, New Delhi. ISBN: 9780198085423, 2011.
2. Chandra A.M. and Ghosh S.K., "*Remote Sensing and Geographical Information System*", Narosa Publishing House, New Delhi. ISBN: 978-1842652788, 2006.
3. Joseph G. and C. Jeganathan, "*Fundamentals of Remote Sensing",* University Press, Hyderabad. ISBN: 9788173715358, 2018.
4. Kang-tsung Chang, "*Introduction to Geographic Information Systems*", McGraw-Hill Education, 4th edition, ISBN: 9780070658981, 2017.
5. Lillesand T.M., Kiefer R.W. and Chipman J.W., "*Remote Sensing and Image Interpretation*", 5th edition, John Wiley and Sons, India, ISBN: 978-8126513352, 2011.
6. Richards J.A. and Xiuping Jia, "*Remote sensing digital image analysis: An Introduction*" 4th edition, Springer, 1999, ISBN: 9788181288660.
7. Rao G.S., "*Global Navigation Satellite System*", Tata McGraw-Hill Education Pvt. Ltd., New Delhi, ISBN: 978-0070700291, 2010.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Apply up-to-date information of optical remote sensing to map surface of earth.
2. Ability to develop various thematic maps.
3. Use Geoinformatics for location based mapping and monitoring.
4. Understand to apply Geoinfromatics to solve problems related with utility sector.

3SE82: ADVANCED STRENGTH OF MATERIALS
CREDITS – 4 (LTP: 3,0,1)

Course Objectives:

1. To impart knowledge of analysis for structural elements.
2. To explain various theories of failure.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
03	00	02	04	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Strain energy:** Resilience, Proof resilience, modulus of resilience,Gradual, sudden and Impact loads, Energy of dilation and distortion, Castigliano's theorem, Maxwell's theorem of reciprocal deflection	9
2	**Stresses in Springs:** Leaf spring, deflection and bending stresses; open coiled helical springs; derivation of formula and application for deflection and rotation of free end under the action of axial load and/or axial couple; flat spiral springs – derivation of formula for strain energy, maximum stress and rotation	7
3	**Theories of Failure:** Maximum principal stress theory, maximum shear stress theory, Total strain energy theory, shear strain energy theory, graphical representation and derivation of equation for each and their applications.	7
4	**Bending of curved elements:** Calculation of stresses in crane or chain hooks, rings of circular section and trapezoidal section and chain links with straight sided	5
5	**Shear flow in elements:** Shear stress distribution in rectangular, circular,I,T and channel section and the compression with bending stresses, Shear flow in thin walled open sections, Determination of Shear centre, Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.	6
6	**Thick Cylinders:** Derivation of Lame's equations, calculation of radial longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts	5

Unit No.	Topics	Teaching Hours
7	**Rotational stresses:** Rotational stresses in discs and rims of uniform thickness; discs of uniform strength	6
	Total	**45**

List of References:

1. S. P. Timoshenko and D. H. Young, "*Elements of Strength of Materials*" East West Press.
2. GH Ryder, "Strength of Materials", MacMillan and Co.
3. R.S. Lehri and A.S. Lehri, "*Strength of Materials*", S.K Kataria and Sons
4. Advanced Soild Mechanics by LS Srinath, McGraw-Hill.
5. Introduction to Mechanics of Solids by Crandell, Dahl and Lardner, McGraw Hill
6. Advanced Mechanics of Materials by Fred B. Seely and James O. Smith
7. Fundamentals of Solid Mechanics (A Treatise on Strength of Materials) by M. L. Gambhir, PHI Learning pvt. Ltd.
8. Strength of Materials by R. K. Rajput, S. Chand Publisher.
9. Mechanics of Materials by Dr.Kirpal Singh, Standard Publishers & Distributors.

Course Outcomes (COs):

1. Apply the strain energy concept to structural elements.
2. Apply theories of failure in structural elements.
3. Analyze curved elements.
4. Analyze different stresses in thin walled sections, thick shells and rotating elements.

3SE83: BASIC CONCEPTS OF STRUCTURAL BEHAVIOUR
CREDITS – 4 (LTP: 3,0,1)

Course Objectives:

1. To impart the basic concepts of behaviour of different structures.
2. Introduction to Structural Analysis and Design criteria of structural elements.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Structures and Overview:** Classification, Basic issues in analysis and design of structures. Types and	12

Unit No.	Topics	Teaching Hours
	selection of suitable structural system.	
2	**Principles of Mechanics:** Internal forces and moments. Mechanical properties of building materials.	10
3	**Analysis and Design criteria:** Introduction to Structural Analysis and Design criteria of structural Elements like truss, Cable, arch, Beam, Column and Shell.	15
4	**Plate and Grid structures:** Introduction to plate and grid structures	08
	Total	**45**

List of References:

1. Daniel L.Schodek, "Structures", Prentice Hall
2. S. B. Junnarkar and H. J. Shah, "Applied Mechanics", Charotar Publishing House Pvt. Ltd.
3. S. B. Junnarkar and H. J. Shah, "Mechanics of Structure Vol. I", Charotar Publishing House Pvt. Ltd.
4. Popov E.V., "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi.
5. Hibbler R. C., "Structural Analysis" Pearson Education.
6. Patil H.S., Patil Y.D. and Patel Jignesh, "Structural Analysis-I", Synergy Knowledgeware.
7. Charles E. Reynolds, James C. Steedman (Author), Anthony J. Threlfall, "Reinforced Concrete Designer's Handbook"; CRC press-Taylor and Francis.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand different structural systems and their behaviour.
2. Compute internal forces and moments induced in structural systems due to different types of loading and apply the knowledge of building materials to structural engineering problems.
3. Analyze different structural systems and apply design concepts to them.
4. Understand plate and grid structures and their behaviour.

3CP83: PROGRAMMING WITH PYTHON
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

To impart programming skills of python programming language.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction** Basic elements of python; Control Structures; Strings and Inputs.	04
2	**Functions, Scoping and Abstraction** Functions and scoping; Specifications; Recursion; Global variables; Modules; Files; System Functions and Parameters.	06
3	**Structured Types, Mutability and Higher-Order Functions** Tuples; Lists and Dictionaries; Lists and Mutability; Functions as Objects.	04
4	**Testing, Debugging, Exceptions and Assertions** Types of testing; Black-box and Glass-box; Debugging; Handling Exceptions; Assertions.	04
5	**Classes and Object-Oriented Programming** Abstract Data Types and Classes; Inheritance; Encapsulation and Information Hiding.	05
6	**Advanced Topics** Plotting using PyLab; Network Programming – Sockets; Graphics and GUI Programming; Drawing using Turtle, Tkinter and Python; Other GUIs; Database Access.	15
7	**Hardware Interfacing** Introduction; Arduino IOP, Programming PYNQ-Z1's onboard peripherals - LEDs, switches and buttons; Peripheral Example; Controlling a single LED; Controlling all the LEDs, switches and buttons	07
	Total	**45**

List of References:

1. John V Guttag. "*Introduction to Computation and Programming Using Python*", Prentice Hall of India
2. R. Nageswara Rao, "*Core Python Programming*", dreamtech
3. Wesley J. Chun. "*Core Python Programming - Second Edition*", Prentice Hall
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "*Data Structures and Algorithms in Pyhon*", Wiley
5. Kenneth A. Lambert, "*Fundamentals of Python – First Programs*", CENGAGE Publication
6. Luke Sneeringer, "*Professional Python*", Wrox

Course Outcomes (COs):

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

1. Develop proficiency in creating applications using the Python Programming Language.
2. Describe various data structures available in Python programming language and apply them in solving computational problems.
3. Test the code written in Python.
4. Draw various kinds of graphs using PyLab.
5. Perform interfacing with different hardware.
6. Create applications with graphical user interfaces.

3CP84: INFORMATION TECHNOLOGY ESSENTIALS
CREDITS - 4 (LTP: 3,0,1)

Course Objective:
To provide basic knowledge of the technologies needed for application development.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Networking Essentials** Fundamental computer network concepts, Types of computer networks,, Network layers, TCP/IP model, Wireless Local Area Network, Ethernet, WiFi, Network Routing, Switching, Network components, web server	04
2	**Web Essentials** Creating a Website, Working principle of a Website, Browser fundamentals, Authoring tools, Types of servers: Application Server, Web Server, Database Server, HTML basics, HTML tags and their use, CSS	07
3	**Scripting Essentials** Need for Scripting languages, Types of scripting languages **Client side scripting** Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, **Server side scripting** PHP, Working principle of PHP, PHP Variables, Constants, Operators, Flow Control and Looping, Arrays, Strings, Functions, Cookies, Sessions, database connectivity	20
4	**Database Essentials** Database management, Database terms, MySQL, commands, Data types, DDL and DML Queries, Accessing MySQL using PHP.	10
5	**Application Essentials** Design and development of real time information systems using database connectivity, networking and scripting languages.	05
	Total	**45**

List of References:

1. Ralph Moseley and M.T. Savaliya, *"Developing Web Applications*", Wiley-India.
2. Harwani, "*Developing Web Applications in PHP and AJAX*", McGrawHill
3. A Silberschatz, H F Korth and S Sudarshan, "*Database System Concepts*", McGraw Hill. (E-book available on the BVM intranet).
4. Behrouz A Forouzan, "*Data Communication and Networking*", 5th Edition, McGraw Hill, 2013 (E-Book available on the BVM intranet)
5. W3Schools is a web developers site, with tutorials and references on web development languages such as HTML, CSS, JavaScript and PHP. URL: https://www.w3schools.com/
6. MDN Web docs. URL: https://developer.mozilla.org/en-US/

Course Outcomes (COs):

At the end of this course students will be able to…

1. Understand the basics of networking.
2. Design and deploy website using HTML and CSS.
3. Design and develop simple web application using client side and server side scripting.
4. Understand database management system.
5. Formulate basic SQL queries.
6. Develop applications using information technologies.

3CP85: OBJECT ORIENTED CONCEPTS AND PROGRAMMING
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

To impart knowledge about the principles of object-oriented programming paradigm using C++.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Overview and Concepts of C++** Review of fundamental concepts of Object-oriented programming, Procedural Vs. Object Oriented Programming, Principles of OOP , Benefits and applications of OOP, Introduction to C++, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures	**05**

Unit No.	Topics	Teaching Hours
2	**Objects and Classes** Basics of object and class; Private and public members; static data and function members; constructors and their types; destructors; type conversion; new and delete operators. Arrays of objects; Reference variables.	**10**
3	**Functions and Inheritance** Simple functions; Call and Return by reference; Inline functions; Macro Vs. Inline functions; Operator overloading; Overloading of functions; default arguments; friend functions; Concept of Inheritance; types of inheritance: single; multiple; multilevel; hierarchical; hybrid; protected members; overriding; virtual base class.	**10**
4	**Dynamic Polymorphism** Pointers and Objects; this pointer; virtual and pure virtual functions; Implementing dynamic polymorphism.	**05**
5	**I/O and File Management** Concept of streams; cin and cout; Overloading of inserter and extractor operators; C++ stream classes; Unformatted and formatted I/O; manipulators; File stream and C++ classes; File management functions; File modes; Binary and random Files.	**05**
6	**Exception Handling** Review of traditional error handling; basics of exception handling; exception handling mechanism; throwing mechanism; catching mechanism; rethrowing an exception; specifying exceptions, Introduction of Advanced topics.	**06**
7	**Introduction to Java** Introduction, OOP basics, Packages, Interface.	**04**
	Total	**45**

List of References:

1. E Balagurusamy, "*Object Oriented Programming with C++",* McGraw-Hill (E-book available on the BVM intranet)
2. Herbert Schildt, "*The Compete Reference C++",* McGraw-Hill
3. Deitel, "*C++: How to Program*", PHI
4. Jana Debasish, "*C++ and Object Oriented Programming Paradigm*", PHI
5. Saurav Sahay, "*Object Oriented Programming with C++",* Oxford
6. Herbert Schildt, "*The Complete Reference, Java*", McGraw-Hill.

Course Outcomes (COs):

At the end of this course students will be able to…

1. Differentiate between object-oriented programming and procedural programming paradigms
2. Understand features of object-oriented programming like encapsulation, inheritance, polymorphism, etc. using C++
3. Design a solution to a given problem using object-oriented programming concepts
4. Prepare an application in C++ using I/O, File management and exception handling concepts.
5. Understand concepts of OOP with Java.
6. Enhance logical reasoning and programming skills.

3IT85: WEB APPLICATION AND DEVELOPMENT
CREDITS – 4 (LTP: 3,0,1)

Course Objective:
To learn the concepts of web designing to design and implement web application.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Web server, Access and security, Web Protocol(HTTP/1.1):** Overview of HTTP, HTTP language elements, HTTP extensibility, SSL and security, Evolution of HTTP/1.1 protocol 2.8 methods-headers and response codes in 1.0 /1.1, Cloud Web hosting, Web Server Basics.	3
2	**Web Design:** Concepts of effective web design, Web design issues including browser, Bandwidth and cache, Display resolution, Look and feel of the website, Page layout and linking, Sitemap, Planning and publishing website.	4
3	**HTML:** Basics of HTML, Formatting and fonts, Commenting code, Color, Hyperlink, Lists, Tables, Images, Forms, Frames, Browser architecture and web site structure.	6
4	**HTML5:** HTML5 New Element, HTML5 Canvas, HTML5 Drag/Drop, HTML5 Video, HTML5 Audio, HTML5 Input type, HTML5 Form Element, HTML5 Form Attribute, Features of HTML5.	5
5	**Style sheets:** Need for CSS, Introduction to CSS, Basic syntax and structure, Background images, Colors and properties, Manipulating texts, Using fonts, Borders and boxes, Margins, Padding , lists, Positioning using CSS, CSS2, Overview and features of CSS3.	7
6	**JavaScript:** Client side scripting with JavaScript, Variables, Functions, Pop up boxes, The DOM and web browser environments, Manipulation using DOM, Forms and validations. **DHTML:** Combining HTML, CSS and JavaScript, Events and buttons.	8
7	**PHP:** Introduction and basic syntax of PHP, PHP and HTML, Arrays, Functions, String, Form processing, Files, Advance Features: cookies and sessions.	6

Unit No.	Topics	Teaching Hours
8	**PHP and MySQL:** Introduction to MySQL, Connection to server, Creating database, Selecting a database, Creating a table, Inserting data, Altering tables, Queries, Deleting database, Deleting data and tables.	6
	Total	**45**

List of References:

1. Ralph Moseley and M. T. Savaliya, *"Developing Web Applications"*, Wiley-India.
2. Black Book, *"Web Technologies"*, dreamtech Press.
3. Black Book,*"HTML 5"*, Dreamtech Pr.
4. Joel Sklar, *"Web Design"*, Cengage Learning.
5. Harwani, *"Developing Web Applications in PHP and AJAX"*, McGrawHill.
6. P.J. Deitel & H.M. Deitel, *"Internet and World Wide Web How to program"*, Pearson.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Able to understand internet concepts that are vital in understanding web development.
2. Understand the role of computer languages and protocols in the workings of the web and able to explain the roles of web development.
3. Describe the strengths and weaknesses of the client-server internet approaches to web design and implementation.
4. Design and apply markup languages for processing, identifying, and presenting of information in web pages.
5. Design and implement an interactive web site(s) with regard to issues of usability, accessibility and internationalization.
6. Design and implement a client-server internet application that accommodates specific requirements and constraints, based on analysis, modeling or requirements specification.

3IT86: JAVA PROGRAMING
CREDITS – 4(LTP: 3,0,1)

Course Objective:

To be familiar with different object oriented concepts which are commonly applied in implementation of various java applications using business logic.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to JAVA:** Object-oriented programming paradigms & principles, Key features of JAVA, Byte code and Java development Kit, Lexical issues, Data types, Variables, Control statements, Loop.	4
2	**Arrays and Operators:** One-dimensional arrays, Multi-dimensional arrays, Arithmetic operators, The bitwise operators, Shift operators, Relational operators, Short-circuit logical operators, The? operator, Operator precedence.	4
3	**Introduction to Classes and Methods:** Class Fundamentals, Declaring objects, Assigning object reference variables, Introducing methods, Constructors, Overloading methods, Overloading constructors, Using objects as parameters, Recursion, Passing and returning object form method, Introducing nested and inner classes, Command-line arguments, Understanding keywords: this, final & static.	6
4	**Inheritance and String Handling:** Inheritance basics, Super keyword, Multilevel hierarchy, Method overriding, Dynamic method dispatch, Using abstract classes, The object class, Special string operations, Character extraction, String comparison, Searching strings, Modifying a string, Data conversion using valueOf( ), String Buffer class & its methods.	4
5	**Packages and Interfaces:** Defining a package, Finding packages and CLASSPATH, Access protection, Importing packages, Defining an interface, Implementing interfaces, Applying interfaces, Variables in interfaces.	4
6	**Exception Handling:** Exception-handling fundamentals, Exception types, Use of try and catch, Multiple catch clauses, Nested try statements, Throw, Throws, Finally keywords, Java's built-in exceptions, Custom exception, Chained exceptions.	6
7	**Multithreaded Programming:** The java thread model, Creating a thread using implementing runnable & extending thread, Creating multiple threads, isAlive( ) and join( ), Thread priorities, Synchronization, Deadlock.	4
8	**Input/Output and File Operation:** Streams, Byte streams and character streams, The predefined streams, Reading console input, Writing console output, The PrintWriter class, Reading and writing files.	4
9	**The Applet Class:** Applet basics, Applet architecture, An applet skeleton, Simple applet display methods, Repainting, Using the status window, The HTML APPLET tag, Passing parameters to applets.	4

Unit No.	Topics	Teaching Hours
10	**Introducing the AWT and Graphics:** AWT classes, Window fundamentals, Working with frame windows, Creating a frame window in an applet, Working with graphics: Drawing lines, Rectangles, Ellipses, Circles, Arcs and polygons, Sizing graphics, Working with color, Working with fonts.	5
	Total	**45**

List of References:

1. Herbert Schildt, *"The Complete Reference, Java 2",* Ninth Edition, Tata McGraw Hill .
2. Herbert Schildt & Dale Skrien, *"Java Fundamentals A comprehensive introduction",* Tata McGraw Hill .
3. E.Balaguruswamy, *"Programming with Java A Primer",* Tata McGraw Hill.
4. Horstmann & Cornell, *"Core Java Volume-I Fundamentals",* Eight Edition, Pearson Education.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Create java program for simple business logic.
2. Understand the concept of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.
3. Identify classes, objects, members of a class and the relationships among them needed for a specific problem.
4. Demonstrate programs on exceptions, multithreading, various collection classes and applets.
5. Understand the concept of file handling.
6. Identify various event classes and methods which are needed for event based applications.

3IT87: OBJECT ORIENTED PROGRAMMING WITH C++
CREDITS – 4(LTP: 3,0,1)

Course Objective:

Analyzing and solving the real-world problems using various concepts of object oriented programming.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to C++:** Introduction OOP, Procedural VS. Object oriented Programming, Basic concept of OOP, Principals of OOP, Benefits and applications of OOP, Programming in C++.	3
2	**Data types, operators and Control Structures:** Data Types, Keyword, Tokens, identifiers, variables, constants, enum, operators, typecasting, control structures.	4
3	**C++ Functions:** Function Prototyping, Call by value and reference, Return by reference, Inline function and macro function, Default Arguments, Function Overloading.	5
4	**Class and objects:** Structure vs Class, Member function Declaration, Access Specified for member function, Static data Member and Member Function, Friend Function, Object as Argument, Constructor, Types of Constructor, Destructor.	6
5	**Operator Overloading and Type Conversion:** Unary and Binary Operator Overloading, Types of Type Conversion.	5
6	**Inheritance:** Inheritance, Types of Inheritance, Virtual Base Classes, Abstract Class, Constructor in Derived Class.	5
7	**Virtual Function and Polymorphism:** Polymorphism, Types of Polymorphism, this Pointer, Virtual Function, Pure Virtual Function.	5
8	**I/O functions:** Formatted and Unformatted I/O Operations, Manipulators.	4
9	**File Management:** Classes for File Operations, Basic File Operations, File Functions, Error Handling Operations, Command Line Arguments.	4
10	**Exception Handling:** Try, Catch and Throw, Multiple Catch, Re-throw Exception.	4
	Total	**45**

List of References:

1. E Balagurusamy, *"Object Oriented Programming with C++",* Second Edition,Tata McGraw Hill.
2. Herbert Schlitz, *"The Compete Reference C++",* Second Edition, Tata McGraw Hill.
3. Ashok Kamthane, *"Object Oriented Programming with ANSI and Turbo C++",* Pearson.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Design and analyze real world problem effectively.
2. Understand functions and parameter passing.
3. Differentiate the use of class and structure to develop a program.

4. Develop a program show usage of abstraction.
5. Design effective program using various IOS functions.
6. Create a file to manage data using object oriented programming.

3IT88: MOBILE APPLICATION DEVELOPMENT
CREDITS - 4 (LTP: 3,0,1)

Course Objective:
Design and develop useful Android applications with compelling user interfaces by using, extending, and creating your own layouts and Views and using Menus.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Basics of Android Programming:** Introduction, History, Features and android architecture, Introduction to java and android, Introducing development framework, Dalvik virtual machine – DVM, Installation of Android Studio, Android virtual device (AVD) and SDK manager, Android manifest file,	8
2	**Android Building Blocks:** Types of android applications, Activity lifecycle, Intents, services, Content provider, broadcast receivers, Activity classes, Component lifecycle,Layouts,Views and Resources, Activity with Implicit Intents.	7
3	**Android User Interface :** Buttons,RadioButtons,checkboxes,Pickers,Spinners,Menus:Optionsmenu,contextual menu, Popup menu, Adding menu items, Navigation: Screen Navigation, navigation drawer, Theme and Styles: uses of drawable in android	7
4	**Multimedia in Android:** Introduction to audio and video in Android, Android persistence, Android preferences, Using file system, Accessing SD cards, Location and maps, Using GEOCoder, Android text to speech, Paranoid android, Internet services, Broadcast receivers, Sensor manager, different Parsing techniques like JSON Parsing and SAX Parsing.	10

Unit No.	Topics	Teaching Hours
5	**Database Connectivity**: SQLite database, SQLite data types, Cursors and content values, SQLite open helper, Adding, Updating and deleting content, Firebasedatabase, connection of firebase database with android app.	7
6	**Test and Debug Android Application :** Basics of testing, testing and commercializing applications, Activity testing, service testing, Content provider testing, Test classes, Debugging using DDMS, Configuration changes, Security and permissions, Web services integration, Deployment.	6
	Total	**45**

List of References:

1. Mike Wolfson, *"Android Developer Tools Essentials"*, O'Reilly Media Publications.
2. Jeff Friesen, *"Learn Java for Android Development",* A press Publications, 2nd Edition.
3. Kevin Brothaler*, "OpenGL ES 2 for Android -The Pragmatic Programmers"*.
4. Wei-MengLee, John Wileyand sons, *"Android Application Development Cookbook",*2013

Course Outcomes (COs):

At the end of this course students will be able to …

1. Design and develop user Interfaces for the Android platform.
2. Gain knowledge to create and publish their own Apps for Android devices
3. Understand the limitations and features of developing application for mobile devices
4. Learn database connectivity using real time database.
5. Analyze different parsing techniques.
6. Apply different Testing techniques on android applications.

3EE82: RENEWABLE ENERGY TECHNOLOGIES (O.E-II)
CREDITS - 4 (LTP: 3,0,1)

Course Objectives:

The subject aims to provide the student with the knowledge of upcoming renewable energy technology, applications and be able in the future to design and development of various energy technologies.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course content:

Unit No	Topics	Teaching Hours
1	**Introduction:** Renewable Sources of Energy, Grid-Supplied Electricity, Distributed Generation-Renewable. Various non-conventional energy resources; Introduction, availability, classification, relative merits and demerits. Energy Policy and Regulations, CDM prospects (carbon credits)	6
2	**Solar Energy:** Introduction ,Photo voltaic power generation, spectral distribution of energy in solar radiation, solar cell Configurations, voltage developed by solar cell, Solar Cell Efficiency and losses , practical solar cell performance, commercial photo voltaic systems, specifications for PV systems, Applications , Design of roof top solar PV system .Introduction and Application of Solar thermal Energy .	6
3	**Wind Energy :** Introduction, Site selection criterion, Classification of wind power plants, wind characteristics, performance and limitations of energy conversion systems. Power from wind, properties of air and wind, types of wind Turbines, operating characteristics, New Developments.	6
4	**Geothermal Energy:** Introduction ,Resources of geothermal energy, Types of Geo thermal Energy , Environmental Consideration, Power generation methods, Hybrid systems	6
5	**Wave and Tidal Wave energy:** Introduction, Mechanism and wave motion, Properties of waves and power content, vertex motion of waves, Device applications. Types of ocean thermal energy conversion systems, Application of OTEC systems, Examples.	6
6	**Biomass Energy Conversion:** Introduction, Technologies available for thermal and power generation applications, Bio-fuels and decentralized energy systems (Co—operative Rural power plant, Biogas generation, Waste minimization and utilization.	6
7	**Advanced Technologies:** Introduction of Green Building Concepts, CO_2 Sequestration, Electric Vehicle, Fuel Cells, Hydrogen Energy, Building material selection ,Designing of building ,Heat transfer concepts ,Green building rating systems etc.	6
	Total	**42**

List of References:

1. G. D Rai, "*Non-conventional energy sources*", Khanna Publishers.
2. Chetan Singh Solanki, "*Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers*", PHI Publisher, 2013.
3. S.P. Sukhatme, "*Solar Energy - Principles of thermal collection and storage*", TMH, 2008.
4. Dr. R K Singal, "*Non-Conventional Energy Resources*", S.K Kataria & Sons.
5. Thomas Ackermann, "*Wind Power in Power System*", John Willey &Sons, 2005.
6. Felix A. Farret, M. Godoy Simoes, "*Integration of Alternative Sources of Energy*", John Wiley & Sons, 2006.

Web Resources:

1. Non-Conventional Energy Systems, Electrical Engineering Prof. L. Umanand, IISc Bangalore https://nptel.ac.in/courses/108/108/108108078

Course Outcomes (COs):

After learning this course the students will be able to:

1. Comprehend Solar Energy technologies and applications.
2. Learn wind and other Energy generation technologies and applications.
3. Design of solar PV system and associated problems.
4. Identify Energy generation problem as per environmental conditions and Geographical Locations.
5. Learn advance technologies and limitations.
6. Solve Field problems using recent technological development as per need of an hour.

3EE84: INDUSTRIAL AUTOMATION
CREDITS - 4 (LTP:3,0,1)

Course Objectives:

Understand automation technologies and identify advantages, limitations and applications of the same. Develop ability to recognize, articulate and solve industrial problems using automation technologies.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Details of Assessment Instruments under CE Practical Component:

Term work [15]	Allied Evaluation [15]
Report/Presentations/Assignment/Journal	Performance/Quiz/ Questions & Answers

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Programmable Logic Controller (PLC) :** An overview of PLC, introduction, definitions and history of PLC, manufacturing and assembly processes, PLC advantages and disadvantages, overall PLC system, CPU, PLC, input and output modules, program recording	6

Unit No.	Topics	Teaching Hours
	devices, general programming procedure, Input and Output module interfacing, relation of digital gate logic to contact / coil logic	
2	**PLC Programming:** Creating ladder diagrams from process control descriptions, basics of register.	6
3	**PLC Functions:** Timer function, Counter function, Arithmetic function, Number comparison functions, Numbering systems and number conversion function, Skip and Master control relay functions, Jump functions, PLC data move systems, Digital bit functions and applications, Sequencer function.	8
4	**Analog PLC operations:** Different PLC operations, applications of PLCs: Stepper motor control, speed control of D.C. motor & Induction motor, lift/elevator control, water level control, Traffic control, Temperature control.	6
5	**HMI: A**rchitecture, types and specifications, Interfacing and Networking with PLC, **SCADA:** Introduction, features and applications.	5
6	**Introduction to Distributed Control System:** DCS architecture, Communication Protocol.	4
7	**Introduction to Industry 4.0** History of industrial revolutions, concept of IR4.0, typical architecture of IR4.0, design principles and major role players in IR4.0, advantages and challenges.	5
	Total	**40**

List of Experiments:

Exp. No.	Suggested List of Experiments
1	Introduction to different PLC programming languages.
2	To develop digital circuits using ladder logic and Codesys software.
3	To develop traffic controller logic using ST 2401.
4	To develop water level controller logic using ST 2401.
5	To develop elevator controller logic using ST 2401.
6	Introduction to Dynalog test bench.
7	To demonstrate set and Reset using Push Buttons.
8	To develop NOT, AND & OR logic using switches and indicators.
9	To develop NAND & NOR logic using switches and indicators.

10	To develop industrial control systems.
11	Industry Visit : Process Industry , Automation Industry

List of References:

1. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers", 5th Ed., PHI, 2012.
2. John R. Hackworth, Fredrick D. Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications", Pearson,
3. William Bolton, "Programmable Logic Controllers", 4th Edition, Elsevier.
4. L.A. Bryan and E. A. Bryan, "Programmable Controllers – Theory and implementation," Second edition, An Industrial text company publication, USA, 1997.
5. Richard L. Shell and Ernest L. Hall, "Handbook of industrial automation," CRC press 2000.

Web Resources:

Video Course on "Industrial Automation & Control" by Prof Siddhartha Mukhopadhyay (IIT, Kharagpur) available at:
https://nptel.ac.in/courses/108/105/108105088/

Course Outcomes (COs):

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

1. Understand the basics of PLC programming.
2. Understand the different parameters of PLC.
3. Design different process control applications through ladder logic.
4. Analyze & explain different functions of PLC.
5. Build and experiment with PLC based SCADA systems for various industrial applications.
6. Implement HMI, distributed control system and Industry standard 4.0

3EL82: BASICS OF EMBEDDED AND IOT SYSTEMS
CREDITS –4 (LTP: 3,0,1)

Course Objective:

1. To provide students with good depth of knowledge of Designing Embedded and IOT Systems for various application.
2. Knowledge for the design and analysis of Embedded and IOT Systems for Electronics Engineering students.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Embedded and IoT Systems:** Introduction Embedded and IoT systems, Definition, Examples and components of embedded and IoT Systems, Embedded and IoT Systems Design Process, Various Embedded and IoT cores controllers.	5
2	**Hardware/Software Co-design for Embedded and IoT Systems:** Microcontrollers for embedded systems, Arduino embedded platform, Peripheral interfacing and programming with Arduino platform, Sensors and Actuator interfacing, Cloud support with Arduino platform.	10
3	**Protocols for Embedded and IoT systems:** Serial protocols, UART, I2C, and SPI. NFC, Wireless protocols like, RFID, Zig-bee, IEEE 802.15.4e, Thread, 6LoWPAN, Constrained Application Protocol (CoAP), Extensible Messaging Protocol (XMPP) , WebSocket , Advanced Message Queueing Protocol (AMQP) , Message Queue Telemetry Transport (MQTT), Web Real Time Communications (WebRTC), LoRa, SIGFOX, Z Wave.	10
4	**OS based Software development:** Programming in higher level languages on embedded OS platform, Python and C programming, Various aspects of the OS designed for the IoT environment, open source OS for IoT such as Contiki OS, TinyOS etc.	05
5	**IoT based Embedded Systems:** Basic architecture of an IoT based Embedded Systems., Embedded Hardware for IoT applications, like Raspberry Pi, Arduino, and Raspberry Pi based development board, IoT Cloud Platform and IoT client applications on mobile phones.	05
6	**Case Studies of Embedded and IoT Systems:** Embedded application development through Arduino and Raspberry Pi based development boards, Development of mini Project on new version of Operating systems and development board. That project should also address to the current societal needs.	05
	Total	**45**

List of References:

1. Muhammad Ali Mazidi Shujen Chen, Sepehr Naimi Sarmad Naimi "*Embedded Programming Using C Language",* 1st Edition, Freescale ARM Cortex-M.
2. Steve Ferbur, "*ARM System on Chip*".
3. Rajkamal, "*Embedded System: Architecture, Programming and Design*", TMH3.
4. Dr. OvidiuVermesan, Dr. Peter Friess, "*Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems*", River Publisher

Course Outcome:

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

1. Knowledge of theory and practice related to Embedded and IOT System.
2. Ability to identify, formulate and solve engineering problems by using Embedded Systems with IoT.
3. Ability to implement real field problem by gained knowledge of Embedded Systems with IoT capability.

Sr. No.	Suggested List of Experiments
1.	Study of Open source operating system used in Embedded Design.
2.	Introduction to Arduino based Embedded System Programming.
3.	LED Interfacing program for Arduino based Embedded System
4.	Interfacing Push button Switch interfacing with Arduino based Embedded System
5.	External Peripheral Interfacing with Arduino based Embedded System.
6.	On Chip peripheral programming with Arduino/Raspberry Pi based Embedded System
7.	Serial Communication Protocol programming with Arduino/Raspberry Pi based Embedded Systems.
8.	Wireless communications with Arduino/Raspberry Pi Embedded IOT Platform.
9.	Bluetooth communication interfacing with Arduino/Raspberry PiEmbedded IOT Board.
10.	WiFi module interfacing with Arduino/Raspberry Pi Embedded IOT Board.
11.	Embedded Systems design with IOT capability.
12.	IOT based Temperature monitoring embedded system with open source cloud tools.
13.	Introduction to RTOS
14.	RTOS based task performances

3EL83: SENSORS TECHNOLOGY
CREDITS-3(LTP:3,0,1)

Course Objective:

1. Introduce students to the principle of various Transducers, their construction, applications and principles of operation, standards and units of measurements.
2. Provide students with opportunities to develop basic skills in the understanding the operation of electronic sensors based technology.

Teaching and Assessment Scheme:

Teaching Scheme (Hours Per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Electronics Measurement and Instrumentation:** Transducers and sensors- Accuracy and precisions, types of errors, statistical analysis, probability of errors, limiting errors, sensitivity, linearity, hysteresis, resolution, reproducibility, transfer function.	6
2	**Analog Signal Conditioning:** Signal conditioning, Loading effects, Bridges for measurement techniques, Attenuators and Amplifiers, Passive filters, Op-amp based signal conditioning circuits, Inverting and Non-Inverting Amplifiers, Linearization, Differential amplifiers and Instrumentation amplifiers.	6
3	**Digital Signal Conditioning:** Digital measuring techniques, Sample and Hold Circuits, Comparator, Buffers, D/A Conversion and A/D Conversion, Single channel and multi-channel Data Acquisition System (DAS).	6
4	**Temperature Sensors:** Resistance Vs Temperature characteristics for different materials, Thermistors, Thermocouples - thermoelectric effects for thermocouples, thermocouple tables, RTD, Other Thermal Sensors.	6
5	**Pressure, force, displacement and weight measurement:** Capacitive and inductive transducers, Displacement Sensor (LVDT), Strain Sensors – strain gauges, its principle, applications, types of strain gauges, Load cells, Piezo-electric sensors, Motion sensors.	6
6	**Flow measurement:** Basic principle of flow meter, Differential pressure flow meters, Variable area flow meter, Volumetric flow meter, Hotwire anemometer, Magnetic and ultrasonic flow meter, Rota meter, Hall effect transducer working and measurement techniques.	6
7	**RF sensing:** Basic principle of EM fields, Antenna, RFID, Near Field and Far Field Sensing, Radar and Navigation, EMI & EMC sensing	9
	Total	**45**

List of References:

1. Curtis D. Johnson, *"Process Control Instrumentation Technology"*, Prentice Hall India.
2. D.V.S. Murty, "*Transducers and Instrumentation"*, Prentice Hall India.
3. Helfrick Albert D. and Cooper W. D., "*Modern Electronic Instrumentation and Measurement Techniques"*, Prentice Hall India.
4. Kalsi H. S. *"Electronic Instrumentation"*, Tata McGraw-Hill Education.
5. Shawhney A. K. "*A Course In Electrical and Electronics Measurements and Instrumentation",*DhanpatRai& Sons, 11th Ed., 1999.
6. Bell David A. "*Electronic Instrumentation and Measurements"*, PHI / Pearson Education.
7. Mathew Sadiku, "Elements of Electromagnetics", PHI

Course Outcomes (COs):

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

1. Apply scientific principles for sensing various physical quantities.
2. Understand the operational details of sensors for measurements.
3. Apply measurements techniques for instrumentation.

3EC83: EMBEDDED SYSTEMS AND IOT
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

Understand and Design Arduino based embedded systems for branch specific applications. Understand and Integrate IoT Platforms to enhance application metrics and accessibility.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Topics	Teaching Hours
1.	**Introduction :** Numbering and coding systems, semiconductor memory, CPU architecture, Microcontrollers and Microprocessors, embedded system, Introduction to Arduino Uno and Arduino IDE, Structuring an Arduino Program, Using data types and operations.	04
2.	**IO Port Programming :** Atmega328p pins and functions, IO port programming, Using a Switch, Reading a Keypad, Visual Output, Connecting and Using LEDs, Driving a 7-Segment LED Display, LCD Display.	07
3.	**Serial Communication :** Introduction to serial communication, Sending Formatted Text and Numeric Data from Arduino, Sending and Receiving Serial Data in Arduino, GSM modem, Bluetooth.	07
4.	**Getting Input from Sensors :** Reading Analog Values, Detecting Light, Detecting Motion (Integrating Passive Infrared Detectors), Measuring Distance, Detecting Vibration, Detecting Sound, Measuring Temperature, Reading RFID Tags, Tracking Rotary Movement, Detecting Acceleration.	09

Unit No.	Topics	Teaching Hours
5.	**Physical Output :** Controlling a Servo, driving a Brushless Motor, Controlling Solenoids and Relays, making an Object Vibrate, Controlling the Direction and Speed of a Motor with an H-Bridge, Driving a Stepper Motor.	08
6.	**Introduction to IoT :** Defining IoT, Characteristics of IoT, design of IoT, Functional blocks of IoT, Communication models & APIs, IOT platforms. ESP8266- Introduction. Domain specific applications of IoT : Home automation, Industry applications, Environmental applications.	10
	Total	**45**

List of References:

1. Michael Margolis, "*Arduino Cookbook*", First Edition, O'Reilly Media, March 2011.
2. Muhammad Ali Mazidi, SarmadNaimi and SepehrNaimi, "*The AVR Microcontroller and Embedded Systems: Using Assembly and C*", 1st Edition, Pearson Education, 2012.
3. Michael McRoberts, "*Beginning Arduino*", 2/E, Apress, 2013
4. Cornel Amariei, "*Arduino Development Cookbook*", Packt Publishing, 2019.
5. Michael McRoberts, "*Beginning Arduino*", Second Edition, Apress, 2013
6. Marco Schwartz, "*Internet of Things with ESP8266*", Packt Publishing Ltd., July 2016
7. Marco Schwartz, "*ESP8266 Internet of Things Cookbook*", Packt Publishing, 2017

Course Outcomes (COs) :

At the end of this course students will be able to …

1. Recollect basic knowledge about Digital Systems and microcontroller architecture.
2. Understand functions of Arduino pins and illustrate its use.
3. Integrate serial communication for device interfaces and debugging in applications.
4. Make use of sensors for monitoring different quantities in application.
5. Integrate actuators in application for physical movement and control.
6. Understand concepts of IoT and design IoT applications.

3PE44: DESIGN OF MACHINE TOOLS
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

To apply knowledge of production engineering for design of various machine tools and their sub systems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	150
3	0	2	4	6	4	2	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Machine Tool Drives** Classification of machine tools, working and auxiliary motions in machine tools, machine tool drives, general requirements of machine tool design, engineering design process applied to machine tools.	06
2	**Regulation of speed and feed rates** Aim of speed and feed rate regulation, design of speed box, design of feed box, classification of speed and feed boxes, mechanical stepless regulation of speed and feed rates	10
3	**Design of Machine tool structures** Functions of machine tool structures and their requirements, design criteria for machine tool structures, materials of machine tool structures, profiles of machine tool structures, basic design procedure of machine tool structures, design of beds, columns, housings, cross rails, arms, saddles and carriages.	08
4	**Design of Guideways** Functions and types of guideways, design of slideways, design of anrifriction guideways, protecting devices for slideways	06
5	**Design of Bearings** Classification of bearings, types of sliding contact bearings, design of Journal bearings, types of rolling contact bearings, design of rolling contact bearings.	06
6	**Design of Spindles and spindle supports** Functions of spindle unit and requirements, materials of spindles, design calculations of spindles.	06
	Total	**42**

List of References:

1. N K Mehta, "*Machine Tool Design*", Third edition, Mc Graw Hill Education
2. N. Acherkan, V. Push, "*Machine Tool Design*" Vol-3, University Press of the Pacific
3. V B Bhandari, "*Design of Machine Elements*", Fourth edition, Mc Graw Hill Education
4. V B Bhandari, "*Machine Design Data Book*", Mc Graw Hill
5. S K Basu, D K Pal, "*Design of Machine Tools*", Oxford and IBH Publishing
6. G C Sen, A Bhattacharya, "*Principles of Machine Tools*", New Central Book Agency.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the different types of machine tool drives and mechanisms used in machine tools.
2. Prepare layout of machine tool gear box and select number of teeth on each gear
3. Design the machine tool structures.
4. Design the guideways.
5. Design the spindles and spindle supports.
6. Select bearings for a given applications from the manufacturers catalogue.

3PE45: ADVANCES IN MANUFACTURING PROCESSES
CREDITS - 4 (LTP: 3, 0, 1)

Course Objective:
This course illustrates the advancement in manufacturing in the area of machining, forming and welding processes and their applications.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Non-conventional machining processes** Principles, applications, effect of process parameters – Chemical machining, Electrochemical machining, Electric discharge machining, Electron Beam machining, Ion Beam machining, Plasma Arc machining, Laser machining, Abrasive Jet machining, Ultrasonic Machining	22
2	**Advanced forming processes** Principles, applications, effect of process parameters – Incremental forming, Rubber forming, Hydro-forming, Laser forming, High velocity forming, comparison of high velocity forming and conventional forming: Explosive forming, Magnetic-pulse forming and Electro-hydraulic forming	10
3	**Advanced welding processes** Principles, applications, effect of process parameters - Electo-beam welding, Laser welding, solid state welding processes – friction, explosive welding, ultrasonic welding processes and diffusion bonding, Pulsed current welding process, Under Water welding, Welding of Ceramics, Plastics and Composites	10
	Total	**42**

List of References:
1. Jain V. K., *"Advanced Machining Processes",* Allied Publishers Private Limited, 2007
2. Mishra P. K. *"Nonconventional Machining",* Narosa Publishing House, 2007
3. Kalpkjian S*," Manufacturing Engineering & Technology",* 7th Edition, Pearson, 2016
4. Rowe G. W., *"Principles of industrial metal working process",* CBS Publishers, New Delhi, 2005
5. Narayanswamy R., *"Metal Forming Technology",* Ahuja Publishing House, 2000
6. Schwartz, M.M., *"Metal Joining Manual",* McGraw Hill, NY, 1979
7. Connur, L.P., *"Welding Handbook",* Vol 1 & 2, American Welding Society, 1990
8. Houldcraft, P.T., *"Welding Process Technology",* Cambridge Univ Press, 1985

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the fundamental principle of various advanced manufacturing processes.
2. Select suitable advanced manufacturing processes for economic, ecofriendly and safe manufacturing.
3. Apply the knowledge to select the tooling, process variables and equipment in various advanced manufacturing processes.
4. Determine appropriate process parameters and analyze their effects in various advanced manufacturing processes to improve product quality and productivity.

3PE46: FINITE ELEMENT ANALYSIS
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

To analyze structural, fluid flow & thermal engineering problems, with a separate focus on manufacturing processes by Finite Element Analysis.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Introduction to finite element method, relevance of finite element analysis in design, finite element formulation, modelling and discretization, interpolation, elements, nodes and degree of freedom, application of FEA, advantages and disadvantages of FEM, comparison with Finite Volume Method & Finite Difference Method.	08
2	**One-Dimensional Problems:** General form of the total potential for 1-D, generic form of Finite Element equations, linear bar element, the quadratic bar element, beam element, frame element, one-dimensional fluid flow & heat transfer analysis by finite element method.	16
3	**Two Dimensional Problems:** Introduction, approximation of geometry and field variable, Natural coordinates & coordinate transformation, 2-D elements for structural	18

Unit No.	Topics	Teaching Hours
	mechanics: plane stress, plane strain and axisymmetric problems, body forces, stress calculations, plate and shell elements. Numerical integration, Incorporation of boundary conditions, solution of static equilibrium equations, 2-D fluid flow and heat transfer analysis by finite element method. Applications of FEA in metal joining, metal casting, metal forming & metal cutting.	
	Total	**42**

List of References:

1. P. Seshu, "Text book of *Finite Element Analysis*", PHI Learning Pvt. Ltd .
2. Reddy. J.N., "*An Introduction to the Finite Element Method*", McGraw-Hill Education, 3E
3. Chandrupatla & Belagundu, "*Introduction to Finite Elements in Engineering*", Pearson Education; 4E.
4. Logan, D.L., "A first course in Finite Element Method", Cengage Learning India Pvt. Ltd., 5E.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "*Concepts and*
6. *Applications of Finite Element Analysis",* Wiley India, 4E.

Course Outcomes (COs):

After completion of this subject, the students will be able to…

1. Acquire skills to use finite element analysis.
2. Carry out 1D/2D finite element analysis for structural, thermal & fluid flow engineering problems
3. Apply mechanics of materials and machine design aspects to derive preliminary results used for testing the reasonableness of finite element results.
4. Develop finite element codes in 1D/2D finite element analysis for structural, thermal & fluid flow engineering problems.

3PE47: LEAN AND AGILE MANUFACTURING
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

To understand and implement lean and agile manufacturing principles, tools and factors that contribute to organizational wastes, examining ways to eliminate wastes.

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Topics	Teaching Hrs.
4	**Principles Of Lean Manufacturing:** Review of manufacturing paradigm; Objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing characteristics; Value creation and waste elimination-major kinds of manufacturing waste, concept of takt time, continuous flow, continuous improvement, single piece flow.	9
5	**Lean Manufacturing Concept, Tools And Methodologies**: Primary and Secondary tools: introduction and applications, Values stream mapping (VSM): Current state and future state VSM; Standard work: Communication of standard work to employees, visual controls; Quality at the source, 5S principles, Total Productive Maintenance, Visual Workplace, Work Cell, Changeover and setup time reduction; Production leveling-Failure mode and effect analysis, line balancing, mistake proofing, case studies, Kaizen-worker involvement -cellular layout- administrative lean, Toyota Production System	12
6	**Lean Manufacturing Implementation:** Road map for lean manufacturing implementation; Reconciling lean with other systems, Lean six sigma, integrating lean principles, Lean production in Industry 4.0, Impact of industry 4.0 on lean production system.	9
7	**Agile Manufacturing** Definition, business need, conceptual frame work, characteristics, generic features, CAPP for Agile Manufacturing, Aggregate capacity planning and production line design/redesign in Agile manufacturing, Cellular manufacturing, concepts, examples, Robust design approach, Approaches to enhance agility in manufacturing, Role of QFD, Managing people in Agile organization, Approaches, Applications of multimedia to improve agility in manufacturing, Strategic options in Agile manufacturing	12
	Total	**42**

List of References:

1. Mitra A., *"Fundamentals of Quality Control and Improvement",* PHI, 2nd Ed., 1998.
2. J Evans and W Linsay, The Management and Control of Quality, 6'th Edition, Thomson, 2005
3. Besterfield, D H et al., "*Total Quality Management"*, 3rd Edition, Pearson Education, 2008.
4. S. R. Devadasan, V. Sivakumar, *"Lean and Agile Manufacturing: Theoretical, Practical and Research futurities"*, PHI, 2012Dale H.Besterfiled, *"Total Quality Management",* Pearson Education Asia.
5. Poornima Charantimath, *"Total Quality Management*", Pearson Education Asia 3. Tapan Bose "Total Quality Management", Pearson Education
6. K C Jain and A K Chitale , *"Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000)"* by, Khanna Publishers
7. B. L. Hanson & P. M. Ghare, "Quality Control & Application", Prentice Hall of India

Course Outcomes (COs):

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

1. Identify types of waste in manufacturing system and systematic eliminate it.

2. Study and implement lean and agile principles.
3. Able to implement primary and secondary lean tools in manufacturing system.
4. Analyze and implement objectives and drivers of lean production system to achieve cost reduction and efficient service of customer demands.

3PE48: INDUSTRIAL ROBOTICS
CREDITS – 4 (LTP: 3,0,1)

Course Objective:
To understand and implement concepts of Robot kinematics, peripherals, programming and languages keeping the manufacturing in center.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No	Topics	Teaching Hrs.
1	**Fundamentals of Robot:** Robot definition, Robot anatomy, Co-ordinate system, work envelope, type and classification, specification, Pitch, Yaw, Roll, Joint Notation, speed of motion, pay load, robot parts and functions, need for robots, different applications.	10
2	**Robot Drive System and End Effector:** Drives used in robotics, D.C servo motors, stepper motor, A.C servo motors, salient feature, applications and comparison of drives, end effectors, types of grippers, selection and design considerations.	08
3	**Sensors and Machine Vision:** Requirements of a sensor, Principles and applications of the following types of sensors, position of sensors, range sensors, proximity sensors, touch sensors, wrist sensors, compliance sensors, slip sensors, camera, frame grabber, sensing and digitizing image data, image processing and analysis and object recognition, inspection, identification, visual serving and navigation.	10
4	**Robot Kinematics and Robot Programming:** Forward kinematics, Inverse kinematics and differences, forward kinematics and reverse kinematics of manipulators with two, three degree of freedom, deviations and problems, Teach pendant Programming, Lead through	10

Unit No	Topics	Teaching Hrs.
	programming, Robot programming languages, Motion commands, sensor commands, End effector commands and simple programs.	
5	**Implementation and Robot Economics:** RGV, AGV, Implementation of Robots in Industries, safety considerations for robot operations, Economic Analysis of robots.	04
	Total	**42**

List of References:

1. R.K. Mittal & I.J. Nagrath., *"Robotics & Control",* 2nd Edition, PHI, 1998.
2. Yoram Korean, "*Robotics for engineers*", 6th Edition, Thomson, 2005
3. Groover M P, "*Industrial Robotics*", Pearson Edu.
4. JJ Craig, "*Introduction to Robotic Mechanics and Control*", 3rd edition, Pearson.
5. Fu K S, "Robotics", McGraw Hill.

Course Outcomes (COs):

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

1. Select an appropriate robot type for a specific manufacturing application.
2. Understand the use of sensors and actuators to design and create a robotic application.
3. Plan robot motions and paths.
4. Create, modify, and execute different robot programs.
5. Understand the safety considerations and economic aspects involves in Industrial robots.

3PE49: LOGISTICS & SUPPLY CHAIN MANAGEMENT
CREDITS – 4 (LTP: 3,0,1)

Course Objective:

An understanding of the primary differences between logistics and supply chain management. Analyze the level of uncertainty associated with the supply of products and services to targeted customer segments and justify the choice of a supply chain strategy and its fit with competitive strategy.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction Logistics***:* Introduction, Logistics system design, Demand planning, Multiple channel distribution, Model development, Concept of warehousing, Methods of storage, Primary and secondary transportation, Logistics information system, Logistics costing.	07
2	**Logistics Management:** Nature and scope of logistics, modes of transportation and their performance characteristics, Logistics environment, Logistic decisions: facility location, transportation, storage and material handling. Logistics information systems, Logistics audit and control. Logistics Applications, Logistics & Competitive strategies and global supply chain management, total logistics cost, Logistics to Supply Chain Management focus, Material handling, facility planning and warehousing/storage/retrieval. The role of IT in supply chain, E-supply Chain.	09
3	**Supply chain management:** Overview, Supply chain basics, Decision phases in a supply chain, Planning and operations, Importance of supply chain process, Functional and organizational scope of SCM, Management of Demand and supply in SCM.	07
4	**Supply Chain: Drivers, Metrics & Forecasting**: Drivers of supply chain performance, Framework for structuring drivers, Obstacles to achieving strategic fit. Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting	06
5	**Inventory Management *&* Approach To Design Lean Supply Chains** Traditional Inventory Management, Lean Inventory Management, Kanban Sizing, WIP Inventory: FIFO Management, Kanban-Visual Card, Inventory Reduction through Reducing Lot Sizes, Point of Sale Data. Strategies to configure a lean supply chain for (i) Fast Moving Items, (ii) Slow moving Items and (iii) Dead Stocks Vendor Managed Inventory (VMI),JIT System 99% Syndrome,Standardization,Service Level: How to manage, Lean Logistics	07
6	**Reverse Logistics *&* Sustainable Supply Chain** Issues Involved in Reverse Logistics,Concept of different Reverse Logistics Issues,Product Recall Examples and Implications,Recent Trends in Supply Chain Management Low carbon Supply chains: Concept, Modeling, Case study Food Security Issues and its Supply chains: Concept, Modeling, Case study of FCI,Changing Scenarios in Environmental Clearance, Hazardous Waste Management, *E*-waste Management, etc. in India and International Benchmarks.	06
	Total	**42**

List of References:

1. Lambert, D.M., Stock J.R., "*Fundamentals of Logistics Management*", Irwing McGraw Hill, 1998
2. Sunil Chopra and Peter Menidl, "*Supply chain management- Strategy Planning and Operations*", Prentice Hall, 2001
3. Blanchard, B.S., "*Logistics Engineering & Management*" Prentice Hall, New Jersey, 1997
4. Ronald Ballou, "*Supply Chain Management*", Pearson Education.
5. Sunil Sharma, "*Supply Chain Management – Concepts, Practice & Implementation*", Oxford University Press
6. N. Chandrasekaran, "*Supply Chain Management – Process, Systems and Practice*", Oxford University Press.
7. Coyle, Bardi, and Langley, "*The Management of Business Logistics A Supply Chain Perspective*", Thomson Asia.
8. Walters, Palgrave Macmillan, "*Logistics: An Introduction to Supply Chain Management*".

Course Outcomes (COs):

At the end of this course students will be able to …

1. Demonstrate knowledge of the functions of logistics and supply chain management.
2. Apply concepts and activities of the supply chain to actual organizations.
3. Explain the sequential nature of logistics and supply chain management.
4. Examine the elements leading to effective partnering and strategic sourcing relationships.
5. Produce cases of effective supply chain management and logistics implementation.
6. Explain the role of facilities, inventory, transportation and information as drivers of supply chain performance and the trade-offs associated with a responsive (agile) or efficient (lean) strategy.

4PE01:OPERATION RESEARCH
CREDITS -4 (LTP: 3, 0, 1)

Course Objective:

The core focus of operations research is optimization, i.e.to do things with optimality under the given circumstances or provide a quantitative technique or a scientific approach for making better decisions for operations under their control. Themajor objective of this subject are:

- To build concepts and make learn tools of Operations Research
- To learn mathematical models used in Operations Research
- To apply scientifictechniques constructively to make effective decisions

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**An Introduction:** Historyand definition of operations research (OR), characteristic features of OR, applications and methodology of OR, models and modelling in OR.	03
2	**Linear Programming Problem:** Introduction and characteristics of Linear Programming (LP) problem, formulation of LP Problems, assumptions of LP Models, graphicalsolution for LP problem, special cases in LP, Analytical Methods: Simplex Method, Big-M Method, Two Phase Method, Dual Simplex Method, Duality in linearProgramming, Sensitivity Analysis - Change in (i) objective function coefficient (ii) availability of resources (iii) input-output coefficient andaddition of new variable.	12
3	**Transportation Problem:** Introduction and problem statement of transportation problem, various methods oftransportation problem: north west corner method, least cost method, Vogel's approximation method, modified distribution method, special cases in transportation problem,transhipmentproblems.	08
4	**Assignment Problem:** Various methods for solution of Assignment Problem,complete enumeration method, transportation method, Simplex method and Hungarian Method, variations in AssignmentProblem, Travelling Salesman Problem.	06
5	**Theory of Games:** Game models, two person zero sum games, saddle point, pure and mixed strategies, principle of dominance, solution methods- algebraic method, arithmetic method, graphical method, matrix method, LP method, limitations of Game Theory.	06
6	**Decision and Replacement Theory:** Introduction, decision under certainty, decision under risk, decision under uncertainty: Laplace criterion, Maxi-Min criterion, Mini-Max criterion, savage Mini-Max regret criterion, Hurwicz criterion, Decision tree. Introduction, Replacement policy for equipment which deteriorates gradually, replacement of items that fails suddenly, staff replacement	06
	Total	**42**

List of References:

1. N D Vohra, "*Quantitative Techniques in Management*", Tata McGraw-Hill Education Pvt. Ltd., New Delhi.
2. J KSharma, "*Quantitative Techniques for Managerial Decisions*", MACMILLAN PUBLISHERS, INDIA LTD.

3. Taha, "*Operations Research*", Tata McGraw-Hill Education Pvt. Ltd., New Delhi.
4. RPaneerselvam "*Operations Research*", Prentice Hall of India Pvt. Ltd.
5. P K Gupta & D S Hira "*Operations Research*", S Chand.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Describe the various techniques of operation research.
2. Formulate the optimization problem with initial feasible solution.
3. Analyze & revise feasible solution to achieve optimal solution.
4. Apply scientific techniques to take managerial decisions.

4PE02:PRODUCTION AND OPERATIONS MANAGEMENT
CREDITS -4(LTP: 3, 1, 0)

Course Objective:
To understand role, concepts and tools of Production and Operations Management in the functioning used in organization

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Production and Operations Management:** Introduction, production operations management need and strategy, types of production system with characteristics, tools for implementation of operations, best practices of the industry.	03
2	**Production Planning Control (PPC):** Production Planning: Introduction, function, pre-requisites and steps in process planning, product mix machine or process selection and make/buy decisions, study of route sheet preparation, tool control, loading chart, economic order quantity of manufacture,factors affecting process planning, identification of different production activities, capacity level of each activity, determination of standard hours available,	08

Unit No.	Topics	Teaching Hours
	make or buy decision, bill of material, operation process sheet, plant capacity and machine capacity.	
3	**Forecasting:** Introduction of production forecasting, the strategic role of forecasting in supply chain, time frame, demand behavior, forecasting methods - Qualitative and Quantitative, forecast accuracy.	07
4	**Scheduling:** Introduction and objectives in scheduling, Loading, Sequencing, Monitoring, Single Machine Scheduling (conditions/assumptions of single machine scheduling, various strategies used in 'm' job '1' machine, Flow Shop Scheduling (conditions/assumptions of flow-shop scheduling, Johnson's Algorithm for '2' machines 'n' jobs problems), Job Shop Scheduling, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.	08
5	**Break-Even Analysis:** Introduction, Break-even analysis charts, Break-even analysis for process, plant and equipment selection.	04
6	**Aggregate Operations Planning and assembly line balancing**: Aggregate production planning, adjusting capacity to meet the demand, demand management, hierarchical and collaborative planning, aggregate planning for services, master scheduling, job shop scheduling and Sequencing algorithms, Gantt chart, Line Balancing, LOB, case studies.	06
7.	**Material Requirement Planning:** Introduction, master production schedule, Bill of Material, product structure, ingredients of MRP, MRP calculations, MRP-II	06
	Total	**42**

List of References:

1. Roberta S. Russell, Bernard W. Taylor "*Operations Management*", Pearson PH Dale H Besterfield, "*Total Quality Management*", Person Education.
2. Chase-Jacobs-Aquilano, "*Operations Management for Competitive Advantage*", Tata MacGraw Hill.
3. O. P. Khanna, "*Industrial Engineering and Management*", Dhanpat Rai Publication.
4. Eary and Johson, "*Process Engineering for Manufacturing*", Prentice-Hall.
5. M. S. Mahajan, "*Industrial Engineering and Production Management*", Dhanpat Rai Publication.
6. L. C. Jhamb Vol-I, II, "*Quantitative Techniques*", Everest Publishing House.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Use tools of Production planning and control
2. Understandand Solve forecasting, planning, scheduling and sequencing problems for shop floor
3. Understand and solve aggregate operation planning and assembly line balancing problems for shop floor
4. Demonstrate material requirement planning.

4PE03:QUALITY MANAGEMENT
CREDITS -4 (LTP: 3, 0, 1)

Course Objective:

The course aims to impart basic knowledge about various aspects of Quality Management. The subject provides students with the concepts, fundamentals and techniques required to improve product quality and process efficiency by identifying and measuring production process variability.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Concept of quality and quality management philosophies, dimensions of quality, quality control and quality assurance, quality and productivity, cost of quality, responsibility for quality, strategic quality management, benchmarking.	06
2	**Total Quality Management (TQM)** W. Edwards Deming's contribution to TQM, Juran's contribution to TQM, Crosby's contribution to TQM, Ishikawa's contribution to TQM,Total Productive Maintenance (TPM).	06
3	**Statistical Quality Control** Quality control-its introduction and benefits, variation in processes: factors, process capability & its analysis, control charts for variables and attributes, establishing & interpreting control charts, concept of acceptance sampling, sampling by attributes, single and double sampling plans, inspections by samples, AQL, LTPD, consumers and producer's risk, construction and use of operating characteristic curves, use of standard sampling tables and related IS, sampling by variables, continuous sampling plan, vendor ratings.	08

Unit No.	Topics	Teaching Hours
4	**Acceptance Sampling:** Need for Acceptance Sampling, advantages and disadvantages, sampling by attributes and variables, operating characteristics (OC) curve, sampling related terminology and their interpretation, types of sampling plans, single and double sampling plans, standard sampling system for attributes, sequential, chain and continuous sampling, acceptance sampling by variables.	09
5	**Six sigma and Experimental design** Meaning of Six sigma, the seven magnificent quality tools, introduction of experimental design, Taguchi method in experimental design, concept, application of QFD, case studies.	09
6	**Quality Standards and business excellence models** Quality system standards, Bureau of Indian Standards, Agmark Grading and standardization, Quality council of India, International Organization for Standardization, conformance to specifications, quality assurance, Quality Circles, quality audits, ISO 14000, Customer Operations Performance Centre (COPC) 2000.	04
	Total	**42**

List of References:

1. Kanishka Bedi, "*Quality Management*", Oxford University Press, New Delhi
2. Amitava Mitra, "*Fundamentals of Quality Control and Improvement*", Wiley India Pvt. Ltd., New Delhi
3. Dale H Besterfield, "*Total Quality Management*", Pearson Education.
4. P N Mukharjee, "*Total Quality Management*", Prentice Hall India.
5. M Mahajan, "*Statistical Quality Control*", Dhanpai Rai & Sons, New Delhi.
6. D D Sharma, "*Total Quality Management*", Sultan Chand & Sons.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Realize the significance of quality.
2. Understand and apply the concepts of Total Quality Management.
3. Understand and utilize Statistical Process Control (SPC) data to improve processes,production controls, production planning and decision making.
4. Use and apply quality improvement tools and techniques.
5. Apply knowledge of quality standard for quality management.

4PE04: INDUSTRIAL ENGINEERING
CREDITS - 4 (LTP=3, 0, 1)

Course Objective:

The course focuses on productivity enhancement methods developed to control the diverse components of the system and gives exposure to industrial legislation and various safety acts. To translate innovations into new products a route of entrepreneurship is also put forth into the subject.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Location Selection and Plant Layout:** Nature of location decision, importance of plant location, dynamic nature of plant location, choice of site for selection, comparison of location, principles of plant layout and types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors and process plant. Quantitative methods of Plant Layout: CRAFT and CORELAP, Relationship Diagrams.	06
2	**Cost Accounting & Estimation & Depreciation:** Introduction, definitions, difference between cost accounting & cost estimation, objectives of cost accounting & cost estimation, elements of cost, fixed & variable overheads, determination of selling price, constituents of estimation, various time allowance, estimation of material cost & labor cost, production estimation sheet. Introduction, purpose of calculating depreciation, types of depreciation, methods of calculating depreciation.	04
3	**Productivity Management:** Definition, concept and importance of productivity, difference between production and productivity, tools of productivity, reasons for low productivity, factors that help increasing productivity, productivity index, kinds of productivity measurement, causes of low productivity and techniques of their elimination, factors affecting productivity, technical methods to improve productivity, main contributors to productivity improvement, advantages from increased productivity.	06

Unit No.	Topics	Teaching Hours
4	**Productivity Improvement Methods:** **Method Study:**definition, concept , objectives and procedure of method study, process chart symbols, recording techniques like flow process charts, operation, flow and two handed process charts, flow diagram, string diagram, multiple activity chart, operation analysis, analysis of motion, motion economy, design of work place layout, Therbligs, SIMO chart. **Work Measurement:**definition, concept and objectives of work measurement, stop watch procedure for collecting time study data, time estimating techniques like analytical estimating, Predetermine Motion Time System-PMTS, Elemental Motion Time System, Basic Motion Time System, Method Time Measurement, work factor.	12
5	**Ergonomics**: Introduction, principles, work system design, man-machine system, human behavior and equipment design, tools, techniques and applications, effect of environment on performance of worker.	06
6	**Industrial Legislation & Industrial Acts and Safety:** Need for Industrial legislation, content of ministry of labour &employment in IndiaIndustrial Acts and Safety Factories act, child & women labour, social security, wages, labour reforms, code on wages 2019, content of India code, introduction to Industrial safety, causes and sources of accidents, accident control, safety programme, investigation of accidents, safety devices in machines, welfare and safety, safety and productivity.	06
7	**Entrepreneurship**: concept, product identification, infrastructure facilities, preparation of project report, sources of industrial finance, resources allocation, Government incentives to entrepreneurs	02
	Total	**42**

List of References:

1. Dr. S. K. Sharma & Savita Sharma, “Industrial Engineering and Organization Management”, S. K. Kataria & Sons, New Delhi, 2009
2. M. S. Mahajan, “Industrial Engineering and Production Management”, Dhanpat Rai & Co. Pvt. Ltd., Delhi, 2014
3. Francis R. L. & White J. A., “Facilities Layout & Location”, Prentice Hall
4. O. P. Khana, “Industrial Engineering and Management”, Dhanpat Rai & Co. Pvt. Ltd.
5. M. I. Khan, “Industrial Engineering”, New Age International, 2004
6. Martand T. Telsang, “Industrial Engineering and Production Management”, S. Chand& Co. Pvt. Ltd., New Delhi, 2012
7. Reddy, “Industrial Engineering and Management”, New Age International
8. Dr. Jitendra A. Vadher & Dr. Hemant S. Trivedi, “Industrial Engineering”, Books India Publications, 5th Edition, 2016
9. Introduction to Work study, ILO, Oxford.
10. Banga & Sharma Industrial Engineering and Production Management by Khanna Publishers.
11. Work study by International Labour Organization, ILO

Course Outcomes (COs):

At the end of this course students will be able to …

1. Demonstrate location decision and site selection & prepare plant layouts.
2. Apply work study & method study techniques and understand its significance in productivity enhancement.
3. Know the industrial legislation, industry act & safety.
4. Apply principles of ergonomics.
5. Differentiate Industrial Acts.
6. Understand basic concepts of entrepreneurship.

4PE41: ALLIED MANUFACTURING PROCESSES
CREDITS -3(LTP: 2, 0, 1)

Course Objective:

This course introduces the fundamentals of various allied manufacturing processes and their applications.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Super Finishing Processes:** Introduction, principles, working, effect of process parameters, advantages, limitations and application of super finishing processes: honing, lapping, buffing, polishing, burnishing, abrasive flow finishing, magnetic abrasive finishing etc.	6
2	**Powder Processing:** Introduction, principles, working, effect of process parameters, advantages, limitations and application of powder metallurgy, production of metal/ceramic powders, compaction, sintering of metals and ceramic powders	6
3	**Metal Coating Processes:** Introduction, principles, working, effect of process parameters, advantages, limitations and application of metal coating processes: electro platting, zinc plating, chrome plating, dull plating, cladding, blackening, metal spraying,	10

Unit No.	Topics	Teaching Hours
	anodizing, powder coating, ceramic and glass coating, phosphate coating, physical vapour deposition, chemical vapour deposition, ion implantation, etc.	
4	**Processing of Plastics:** Introduction,principles, working, effect of process parameters, advantages, limitations and application of plastic processing techniques: injection molding, blow molding, extrusion, compression molding, thermo-forming, calendaring.	6
	Total	**28**

List of References:

1. Kalpakjian, S.,*"Manufacturing Processes for Engineering Materials,"* 3rd Ed., Addison – Wesley, 1997
2. Ghosh A. and Mallik A. K., *"Manufacturing Science",* Affiliated East-West, 2000
3. Burakowski, T., and Wierzchon, T.,*"Surface Engineering of Metals: Principles, Equipment, Technologies",* CRC Press, 1999
4. Burnell-Grey, J.S. and Datta, P.K. (eds), *"Surface Engineering Casebook",* Woodhead Publishing Limited, 1996
5. Holmberg, K., and Matthews, A., *"Coatings Tribology: Properties, Techniques and Applications in Surface Engineering",* Elsevier Science B.V., 1994
6. Tai ran Hsu, *"MEMS & Microsystem: Design & Manufacture" ,* Tata McGraw Hill Publisher, 2002
7. Degarmo, Black & Kohser, *"Materials and Processes in Manufacturing",* Prentice Hall of India. 2nd Edition 1998
8. Strong, A. B., *"Plastics: Materials and Processing,"* Pearson Prentice Hall, 2006
9. Jain, V.K., *"Advanced Machining Processes",* Allied Publisher Pvt. Ltd., 2007

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the fundamental principle of various allied manufacturing processes.
2. Select suitable allied manufacturing processes for economic, ecofriendly and safe manufacturing for engineering application.
3. Apply the knowledge to select the process variables, tooling and equipment in various allied manufacturing processes.
4. Determine the appropriate process parameters and analyze their effects in various allied manufacturing processes to improve product quality and productivity.

4PE42: COMPUTATIONAL FLUID DYNAMICS

CREDITS - 3 (LTP: 2, 0, 1)

Course Objective:

To introduce to the students numerical solution of thermal & fluid flow equations (especially by finite volume method) for engineering problems and bring out challenges that arise in solution of such equations.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Computation Fluid Dynamics (CFD):** Industry & research need, methods of computational fluid dynamics, CFD as a design & research tools, applications of CFD.	03
2	**Essentials of Fluid Dynamics & Heat Transfer for CFD:** Physical laws of conservation of mass, momentum & energy, Physical law based differential formulation for mass, momentum & energy, general volumetric & flux terms, and their differential formulation.	12
3	**Computational Heat Conduction, Advection & Convection:** Physical law based finite methods (1D/2D), flux based solution methodology on a uniform grid (Explicit method).	13
	Total	**28**

List of References:

1. J. D. Anderson, Jr., *"Computational Fluid Dynamics: The basics with applications*", International edition, Mc-Graw Hill, 1995.
2. Veersteeg and Malalasekara, *"CFD: The finite volume method*", Prentice Hall, 1996.
3. A. W. Date, *"Introduction to Computational Fluid Dynamics*", Cambridge University Press, 2005.
4. Goshdastidar, *"Computer simulation of flow and heat transfer*", Tata Mc-GrawHill.
5. Atul Sharma, *"Introduction to Computational Fluid Dynamics – Development, Application & Analysis"*, Wiley Publishers, 2017 Edition.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand the phenomenological laws of conservation of mass, momentum & energy.
2. Develop 1D/2D finite volume formulation & discretization for fluid flow & heat transfer problems for given boundary conditions.
3. Develop in-house codes on the basis of finite volume method formulation.
4. Analyse the computed results obtained from the developed programs with experimental results

4PE43: RAPID PROTOTYPING &ADDITIVE MANUFACTURING
CREDITS -3 (LTP: 2, 0, 1)

Course Objective:
This subject gives an exposure to concepts & fundamentals of rapid prototyping & additive manufacturing with possible applications in respective fields of engineering and focuses on production of parts through rapid prototyping (RP) & additive manufacturing (AM) techniques.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Fundamentals of prototype & rapid prototyping:virtual prototyping in product development, rapid prototyping in product development, some general principles of prototyping,commonly used terms, difference between rapid prototyping & additive manufacturing (AM) concepts including classes of prototypes and basic aspects of additive manufacturing, classification & advantages of AM Systems.	05
2	**(a) Additive Manufacturing Process Chain:** Fundamental automated processes, process chain, 3D modeling, data conversion & transmission, checking & preparing, building, and post-processing of component in additive manufacturing process. **(b) Additive Manufacturing Data Formats:** STL format, STL file problems/errors & repairing, Consequences of building a valid & invalid tessellated model, other translators, standard for representing objects manufactured by additive manufacturing methods.	04
3	**Liquid-based Additive Manufacturing:** Stereolithography Apparatus (SLA), polyjet, perfactory, solid object ultraviolet-laser printer (SOUP), bioplotter & bioprinting, rapid freeze prototyping (RFP), other notable liquid-based AM systems - two laser beams, solid ground curing (SGC).	05
4	**Solid-based Additive Manufacturing:** Laminated object manufacturing (LOM), fused deposition modeling (FDM), selective deposition lamination (SDL), paper lamination technology(PLT), benchtop system, multi-jet modeling system (MJM), other notable solid-based AM systems – offset fabber, shape deposition manufacturing (SDM) process.	05

Unit No.	Topics	Teaching Hours
5	**Powder-based Additive Manufacturing:** Selective Laser sintering (SLS), EOSINT Systems, laser engineered net shaping (LENS), electron beam melting (EBM), selective laser melting (SLM), colorjet printing (CJP), aerosol jet system (AJS), Topic to be covered in laboratory: Three dimensional printing (3DP).	05
6	**Applications** &**Evaluation of RP/AM Processes:** Applications of RP/AM techniques in design, engineering analysis, manufacturing & testing, some case studies of aerospace industry, automotive industry, biomedical industry, jewelry industry, coin industry and tableware industry that include variance in materials. Evaluation of the requirements of RP/AM processes in terms of accuracy, finishes, secondary operations, speed, cost, strength & limitations as well as choice of materials for use.	04
	Total	**28**

List of References:

1. Frank W. Liou, *"Rapid Prototyping & Engineering Applications (A text-book for prototype development)"*, CRC Press- Taylor & Francis Group
2. Ali K. Kamrani & Emad Abouel Nasr, *"Rapid Prototyping – Theory and Practice"*, Springer Science+Business Media, Inc., 2006.
3. Chua C. K., Leong Kah Fai & Lim Chu Sing, *"Rapid Prototyping: Principles and Applications",* 2nd Edition, World Scientific Publishing Co. Pvt. Ltd.
4. Chua C. K., Leong Kah Fai & Lim Chu Sing,*"3D Printing & Additive Manufacturing"*, World Scientific Publishing Co. Pvt. Ltd., 2017.
5. Ian Gibson, *"Additive Manufacturing Technologies"*, Springer, 2015.
6. Amit Bandyopadhyay, *"Additive Manufacturing"*, CRC Press, 2015.
7. Andreas Gebhardt, *"Additive Manufacturing"*, Hanser Publications, 2016.
8. Adedeji B. Badiru, *"Additive Manufacturing Handbook"*, CRC Press, 2017.
9. Miltiadis A. Boboulos, *"CAD-CAM & Rapid Prototyping Application Evaluation"*, Download free e-book at BookBooN.com.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand and differentiate the concepts of rapid prototyping & additive manufacturing including classes of prototypes and basic aspects of AM.
2. Understand and describe the AM process chain, classification & advantages of AM Systems.
3. Understand AM data formats, their limitations/errors& standards for AM parts.
4. Understand and explain basic terminologies, specifications, principles, benefits, limitations & applications of various additive manufacturing techniques including process steps, set-ups and case studies related to liquid-based, solid-based & powder-based AM methods.

5. Evaluate the requirements of rapid prototyping processes in terms of accuracy, finishes, secondary operations, speed, cost; strength & limitations as well as choice of materials for use for selection of technique/s for given practical applications.
6. Print a 3D part/component on a 3D printer from a 3D CAD model produced by CAD software.

4PE44: ENTREPRENEURSHIP DEVELOPMENT
CREDITS - 3 (LTP: 2, 0, 1)

Course Objective:

The course focuses on developing and strengthening entrepreneurial quality and motivation in students and impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	100
2	0	2	3	30	20	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Entrepreneurship Development - Concept & Scope:** Charms of becoming an entrepreneur, entrepreneurship: scope in local and global market, steps in setting up of a business, traits of successful entrepreneur.	04
2	**Facility Planning:** Selection of product/service, core competence, product life cycle, new product development process, mortality curve, creativity and innovation in product modification/development. Process selection: technology life cycle, forms and cost of transformation, factors affecting process selection,factors affecting selection of location for an industry. Importance of material handling and its relevance with facility location. Calculate capacity of plant and its relation with economies of scale including flexibility in capacity.	10
3	**Managing Critical Resources:** Managing finance: Sources of finance types, advantages and disadvantages, methods of cost control & importance, managing working capital. Materials Management: MRP, JIT Time management, Developing information system.	06

Unit No.	Topics	Teaching Hours
4	**Support agencies for MSME:** Categorization of MSME, ancillary industries support agencies for entrepreneurship guidance, training, registration. Support agencies for technical consultation, technology transfer and quality control. Support agencies for marketing and finance.	04
5	**Project Planning and Risk Management:** Preparation of business plan and techno economic feasibility study, breakeven point, return on investment and return on sales,planning for calculated risk taking, initiation with low cost projects. Integrated futuristic planning, angel investors, and role of incubation centers.	04
	Total	**28**

List of References:

1. Robert D. Hisrich, "*Entrepreneurship*", McGraw-Hill
2. S.S. Khanka, "*Entrepreneurship and Small Business Management",* Sultanchand and Sons
3. Poornima Charantimath, "*Entrepreneurship Development Small Business Entrepreneurship*", Pearson Education India
4. S Anil Kumar, "*Entrepreneurship Development*", New Age International Publishers
5. Nishith Dubey, "*Entrepreneurship Development"*, PHI Learning
6. Monica Mehta, "*The Entrepreneurial Instinct*", McGraw-Hill

Course Outcomes (COs):

At the end of this course students will be able to …

1. Appreciate role of entrepreneurs in society.
2. Understand the significance of passion, innovativeness, independent decision making, calculated risk taking, assertiveness, persistence, information seeking, commitment to work contract for Entrepreneurship.
3. Prepare prototypes for the innovative ideas considering resource management.
4. Know the entrepreneurship support institutions and schemes.
5. Develop and implement a comprehensive business plan with risk management.

4PE45: PRODUCT DESIGN AND DEVELOPMENT
CREDITS - 3 (LTP: 2, 0, 1)

Course Objective:

Introduce the students about the basic product design process based on mechanical aspects applying innovative thinking and fundamentals.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Product Design & Development:** Product life cycles, characteristics of successful product development, design and development of products, types of design and redesigns, engineering designs, duration and cost of product development, the challenges in product development.	03
2	**Identifying Customer Needs:** Customer satisfaction, voice of customer, customer populations, 08 18 types of customer needs, customer need models. Gathering customer needs: need gathering methods, conducting interviews: like dislike method, articulated-use method, product feel and industrial design, organizing and prioritizing needs: grouping interpreted needs, affinity diagram, determining need importance, customer use patterns, customers need documentation, quality house.	04
3	**New Product Development & Product Management:** Product specification, steps to establish the target specifications, concept generation, five step concept generation method, concept selection, concept screening, concept testing, product architecture, establishing target specifications, setting the final specification. Definition of product & its classification, new product strategy, product management, managing product life cycle, new product development process, different models for new product development. Modern approaches to product design: computer assisted product design, computer aided process planning, role of artificial intelligence in product design, concurrent engineering, product risk analysis.	06
4	**Product Analysis and Material Selection:** Tools and charts used for product analysis like bill of materials, gozinto chart, performance characteristics of materials, material selection process, sources of information on material properties, economics of materials, evaluation methods for material selection.	04
5	**Product Development Processes & Product Planning:** A generic development process, concept development, the front end process, adopting the generic product development process, product planning process.	04

Unit No.	Topics	Teaching Hours
6	**Product Design for Manufacturing & Assembly:** Methods for designing for manufacturing and assembly, design for maintainability, design for environment, legal factors and social issues, engineering ethics and issues of society related to design of products, design for safety, vision and illumination design: climate, noise, motion, sound and vibration, product costing. **(To be covered in practical)**	04
7	**Value Engineering & Value Analysis :** Definition, value engineering and value analysis, difference between value engineering and value analysis, function, approach of function, evaluation of function, determining function, classifying function, evaluation of costs, evaluation of worth, determining worth, evaluation of value, fast diagrams, value engineering job plan, cost models, life cycle costs. **(To be covered in practical)**	03
	Total	**28**

List of References:

1. Kevin Otto, Kristin Wood, *"Product Design",* Pearson Education Inc.
2. K. T. Ulrich & S. D. Eppinger, *"Product Design & Development",* Tata Mc-Graw Hill.
3. Chitale & Gupta, *"Product Development",* Tata McGraw Hill.
4. Niebel & Deeper, *"Product Design & Process Engineering",* Mc-Graw Hill.
5. E. D. Heller, *"Value Management",* Addison Wesley.
6. S. S. Iyer, *"Value Engineering: A how to Manual",* New age International Publishers.
7. Arthur E. Mudge, *"Value Engineering: A Systematic Approach",* Mc-Graw Hill.

Course Learning Outcomes (COs):

At the end of this course students will be able to …

1. Confidence to create a new product based on mechanical design engineering.
2. Know varied aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Analyze and implement knowledge of design for X such as Manufacturing, Assembly, Production, and Maintenance to product.
4. Able to understand Value engineering and Analysis aspects in Product design & development and practical

4PE46: FLEXIBLE MANUFACTURING SYSTEMS
CREDITS -3 (LTP: 2, 0, 1)

Course Objective:

This course aims to introduce the basic concept &fundamentals of flexible manufacturing system and its components.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hrs.
1	**Introduction to Flexible Manufacturing (FMS)** Limitations of conventional manufacturing, significance of FMS & need for FMS, definition, basic component of FMS, general layout and configuration of FMS, principles & objectives of FMS, positive features of FMS, applications of FMS in industry, various hardware and software required for FMS, introduction to CIM technology**.**	4
2	**Manufacturing Cell** Introduction, description and classification of cell, concept of group technology in the part family formation: visual inspection, part coding & classification and production flow analysis, benefits of group technology in FMS, logical arrangement of machines into cell, unattended machining, comparison of cellular and flexible manufacturing.	6
3	**Turning and Machining Centres** Introduction, types, construction and operation performed on turning center, automated features and capabilities of turning centres, introduction to horizontal & vertical machining centers, positive features & limitations of vertical and horizontal machining centers, pallet & part loading, programming options in machining centers, automated features and capabilities of machining centers.	4
4	**Cleaning and Deburring Equipment** Introduction, importance of cleaning and deburring in automated manufacturing, types and working of wash station, types and working of deburring station,.	4
5	**Coordinate Measuring Machines** Introduction, need of automated measurement in FMS, types, construction and general functions of CMM, operational cycle description, CMM applications, linear, angular & profile measurement by CMM.	4
6	**Automated Material Movement and Storage System** Introduction, types of AGV and their principle of working, positive features & limitations, AGV guided path, automated material handling by industrial robots, benefits of using industrial robots, basic components and benefits of automated storage and retrieval systems, conveyors and pallet flotation system, queuing carrousels and automatic work changers, coolant, chip disposal and recovery system.	4

Unit No.	Topics	Teaching Hrs.
7	**Cutting Tools and Tool Management** Introduction, control of cutting tools, tool management, tool strategies, tool preset, identification and data transfer, tool monitoring and fault detection.	2
	Total	**28**

List of References:

1. H. K. Shivanand, M. M. Benal, V. Koti, *"Flexible Manufacturing System",* New Age Publication.
2. Groover M.P, *"Automation, Production Systems and Computer Integrated Manufacturing",* Prentice Hall of India.
3. Groover M.P, Zimmers E.W, "*CAD/CAM",* Prentice Hall of India.
4. Nanua Singh, *"Approach to Computer Integrated Design and Manufacturing",* John Wiley and Sons, 1998.
5. Vajpayee, *"Principles of CIM*", Prentice Hall of India.
6. Luggen W. W., *"Flexible Manufacturing Cells and Systems*", Prentice Hall.

Course Outcomes (COs):

On successful completion of this course the student will be able to….

1. Describe the fundamental concepts of a flexible manufacturing system (FMS), basic components of FMS, its applications and challenges.
2. Apply the concepts to create part family and formation of the flexible manufacturing cell.
3. Describe automated features and capabilities of workstations, material handling and storage system required in FMS
4. Calculate various parameters associated in design of components used in FMS.

4PE47: INDUSTRY 4.0
CREDITS - 3 (LTP: 2, 0, 1)

Course Objective:

1. To familiarize with Industrial Internet of things for planning to embark in the industrial sector.
2. Introduce the tools and techniques that enable IoT solution and security aspects

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				
L	T	P	C	Theory Marks		Practical Marks		Total Marks
				ESE	CE	ESE	CE	
2	0	2	3	30	20	20	30	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Industrial Internet of Things (IIoT):** Introduction to IOT and IIoT, history of IIoT, components of IIoT - IOT market, trends & future real life examples, key terms – IOT platform, role of IIoT in manufacturing processes use of IIoT in plant maintenance practices, sustainability through business excellence tools challenges & benefits in implementing IIoT, scope, history, vertical and business process areas, importance of building ecosystems, IIoT Value Chain – who does what? Industry 4.0: globalization and emerging issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.	07
2	**Introduction: Sensing & actuation, Communication and Networking Sensor and Interfacing** Introduction to sensors, transducers, classification, roles of sensors in IIoT, Various types of sensors, design of sensors, sensor architecture, special requirements for IIoT sensors, role of actuators, types of actuators, interface, networks, people & process, hype cycle, API, clouds, data management analytics, mining & manipulation. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc.	06
3	**Basics of Industrial IoT: Industrial Processes, Industrial Internet Systems** Internet of Things Applications: smart metering, e-Health Body Area Networks, city automation, automotive applications, home automation, smart cards, plant automation, real life examples of IIoT in manufacturing sector, industrial IoT-application domains: factories and assembly line, food industry, power plants, Inventory Management & Quality Control.	07
4	**Industrial IoT: Data Analytics and Networking :** IoT Analytics: role of analytics in IoT, data visualization techniques, Machine Learning and Data Science – data management, programming, Introduction to R Programming, statistical methods, plant safety and security (including AR and VR safety applications), facility management, case studies, privacy, security and governance, advances in IoT.	08
	Total	**28**

List of References:

1. Daniel Minoli, *"Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications"*, ISBN: 978-1-118-47347-4, Willy Publications.
2. Michahelles, "*Architecting the Internet of Things",* ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-1-84821-140-7, Wiley Publications.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "*The Internet of Things: Key Applications and Protocols",* ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
5. Ovidiu & Peter; *Internet of Things- From Research and Innovation to Market Deployment",* River Publishers Series

Course Outcomes (COs): IIoT

At the end of this course students will be able to ….

1. Describe IoT, IIoT and understand, design and develop the real life IoT applications.
2. Understand need of various hardware and software, IoT Layers and their relative importance.
3. Learn various IoT platforms and security and realize the importance of Data Analytics in IoT.
4. Understand the concepts of Design Thinking.

4PE31: PROJECT
CREDITS - 15 (LTP: 0, 0, 15)

Course Objective:

This course allows the students to apply the fundamental knowledge, intellectual abilities, and practical skills learned during the B. Tech. Production Engineering Program to solve real-life engineering problems/situations.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
0	0	30	15	00	00	240	360	600

Details of AssessmentInstruments under CE Practical Component:

The student/s shall present his/her/their progress in the project of the at-least two times in a semester as part of the continuous evaluation to the Departmental Academic Committee (DAC).
The detailed guidelines of the Project are attached in Annexure-A

Course Outcomes (COs):

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

1. Understand the problem, scope, and level of innovation.
2. Design the methodology, interpret the data, and apply the engineering tools to solve the problem.
3. Develop a prototype/working models and/or experimental set-up and/or simulation and other systems capable of meeting the objective.
4. Analyse results to produce useful information and come out with a conclusive solution.
5. Communicate results, concepts, analyses, and ideas in written and oral form.

PEIS1: INTERNSHIP-I
CREDITS-0 (LTP:0,0,0)

Course Objective:

The course aims is to provide an industrial exposure and to understand and learn the system of industrial working in the area of Production Engineering.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
0	0	0	0	0	0	40	60	100

Details of Assessment Instruments under CE Practical Component: NA

Course Contents:

1. It is a Mandatory Non Credit course and the student has to complete an industrial internship for the duration of three weeks during the summer vacation after Semester IV. The internship should be carried out in any industry with relevant applications of Production Engineering, under the guidance of a mentor from the same industry.
2. The student will maintain a log of work done on daily basis and important ideas or practices that he / she has learnt during the internship. The log-book may also be dually signed by the student and the mentor from the industry.
3. The student will submit a detailed report based on the internship immediately after the completion of the internship.
4. The assessment will be based on the following
   (a) Quality of the report and submission of the log book. The report should include the orientation report, product details/drawing of the components, organization chart, plant layout, capacity and capabilities of machine in the shop, functions and interdependence of the department.
   (b) Feedback from the industry mentor in the prescribed form
   (c) Internship completion certificate from the industry
   (d) Performance in a presentation / viva-voce exam

Course Outcomes of Internship/Training (COs):

After completion of the internship students will be able:
1. To understand and get acquaintance with industrial working environment.
2. To learn industrial etiquette and communication.
3. To read part-prints/ assembly drawings and carry out basic dimensional measurements.
4. To relate the subject knowledge to real time engineering situations

PEIS2: INTERNSHIP-II
CREDITS-0 (L=0, T=0, P=0)

Course Objective:

The course aims to provide opportunity for industrial orientation much to correlate the academic exercises carried out during the Production Engineering Program to the industrial practices.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
0	0	0	0	NA	NA	40	60	100

Details of Assessment Instruments under CE Practical Component: NA

Course Contents:

1. It is a Mandatory Non Credit course and the student has to complete an industrial internship for the duration of three weeks during the summer vacation after Semester VI. The internship should be carried out in any industry relevant to the applications of Production Engineering, preferably under the guidance of a mentor from the same industry.
2. The student will maintain a log of work done on daily basis and important ideas or practices that he / she has learnt during the internship. The log-book may also be dually signed by the student and the mentor from the industry.
3. The student will submit a detailed report based on the internship immediately after the completion of the internship.
   The assessment will be based on the following
   a) Quality of the report and submission of the log book. The report should include the orientation report, product details/drawing of the components, organization chart, plant layout, capacity and capabilities of machine in the shop, functions and interdependence of the department.
   b) Feedback from the industry mentor in the prescribed form.
   c) Internship completion certificate from the industry.
   d) Viva-voce exam.

Course Outcomes of Internship/Training (COs):

After completion of the internship students will be able:

1. To understand and get acquaintance and orient in the working environment of industry.
2. To learn industrial etiquette and technical communication.
3. To read part print and assembly drawings, carry out basic dimensional measurement.
4. Understand manufacturing routs/processes to manufacture the product or understand the industrial processes.
5. To relate subject knowledge to real time engineering situations.