SYLLABUS

BACHELOR OF ENGINEERING

PRODUCTION AND INDUSTRIAL ENGINEERING

(SEMESTER SCHEME)

FOUR YEAR INTEGRATED COURSE

B.E. Second Examination, 2015
B.E. Third Examination, 2016
B.E. Final Examination, 2017

JAI NARAIN VYAS UNIVERSITY
JODHPUR

NOTIFICATION

In compliance of decision of the Hon'ble High Court all students are required to fulfil 75% attendance rule in each subject and there must be 75% attendance of the student before he/she could be permitted to appear in the examination.

REGISTRAR
(Academic)

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BACHELOR OF ENGINEERING

(SEMESTER SCHEME)

FOUR YEAR INTEGRATED COURSE

ACADEMIC REGULATIONS

1. Admission:

A candidate for admission to the four year degree programme for B.E (Civil, Chemical, Computer Science & Engineering, Electrical, Electronics & Communication, Information Technology, Mechanical, Mining, Production and Industrial Engineering) must have passed (10+2) Senior Secondary (with English, Physics, Chemistry & Mathematics) of a board situated in the State of Rajasthan or other examinations recognized as equivalent or higher thereto and selected through RPET or otherwise as per the procedure laid down by the University from time to time.

2. The course of study shall extend over a period of four years (eight semesters as an integrated course). A student shall follow the prescribed courses as given in the teaching and examination scheme of the courses to which he is admitted.

3. There shall be a theory examination (Main Examination) at the end of each Semester in Civil, Chemical, Computer Science & Engineering, Electrical, Electronics & Communication, Information Technology, Mechanical, Mining, Production and Industrial Engineering, viz.,

At the end of First Semester

First B.E., First Semester Examination

At the end of Second Semester

First B.E., Second Semester Examination

At the end of Third Semester

Second B.E., Third Semester Examination

At the end of Fourth Semester

Second B.E., Fourth Semester Examination

At the end of Fifth Semester

Third B.E., Fifth Semester Examination

At the end of Sixth Semester

Third B.E., Sixth Semester Examination

At the end of Seventh Semester

Final B.E., Seventh Semester Examination

At the end of Eighth Semester

Final B.E., Eighth Semester Examination

(a) Practical and sessional examinations of I and II semester of First B.E. will be held at the end of II semester of the year.

(b) Practical and sessional examinations of odd and even semester of Second B.E., Third B.E. & Fourth B.E. will be held at the end of each semester of the year.

(c) A candidate will be given mark sheet at the end of semester examination of I, II, III & IV year of the respective semester/year to indicate performance of the candidate as per the scheme of teaching and examination after the declaration of result.

4. The attendance requirement in the Faculty of Engineering & Architecture shall be same as per ordinance as follows:

O. 78-A:

(1) For all regular Candidates in the Faculties of Arts, Education and Social Sciences, Science, Law, Commerce and Engineering the minimum attendance requirement shall be that a candidate should have attended at least 70% of the lectures delivered and the tutorials held taken together as well as 70% for the practical and sessionals from the date of her/his admission.

(2) Condonation of shortage of attendance:

The shortage of attendance up to the limits specified below may be condoned on valid reasons:

(i) Upto 6% in each subject plus 5 attendances in all aggregate of subject/papers may be condoned by the Vice-Chancellor on the recommendation of the Dean/Director/Principal for undergraduate students and on the recommendation of the Head of the Department for the Post-graduate classes.

(ii) The N.C.C./N.S.S. cadets sent out to parades and camps and such students who are deputed by the University to take part in games, athletics or cultural activities may for - Purposes of attendance be treated as present for the days of these absence in connection with the aforesaid activities and that period shall be added to their subject wise attendance.

5. (a) A candidate who has attended a regular course of study in the Faculty of Engineering for the first semester of first B.E. shall be eligible for appearing at the first semester examination of first B.E. for the B.E. degree which shall be common to all branches.

(b) Every candidate appearing for the first semester of first B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended a regular course of study for the

second semester of first B.E. and has appeared in the first semester examination shall be eligible for appearing at the second semester examination of first B.E. for the B.E. degree, which shall be common to all branches.

(d) Every candidate appearing for the second semester of first B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

6. (a) The course of study for the second B.E. Examination shall be separate for all branches of study.

A candidate who after passing I & II semester (combined) of 1st B.E. examination and has attended regular course of study in a particular branch of Engineering for the third semester second B.E. shall be eligible for appearing at the third semester examination of second B.E. in that branch of study.

(b) Every candidate appearing for the third semester of second B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended a regular course of study for the Fourth semester examination of second B.E. and has also appeared in the third semester examination of second B.E. shall be eligible for appearing at the fourth semester examination of second B.E. in that branch of study.

(d) Every candidate appearing for the fourth semester of second B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

7. (a) A candidate who after passing III & IV Semester of second B.E. examination and has attended a regular courses of study in a particular branch of Engineering for the fifth semester of Third B.E. shall be eligible for appearing at the fifth semester examination of third B.E. in that branch of study.

(b) Every candidate appearing for the fifth semester of third B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended a regular course of study for the sixth semester of third B.E. and also has appeared in the fifth semester examination of third B.E. shall be eligible for appearing at the sixth semester examination of third B.E. in that branch of study.

(d) Every candidate appearing for the sixth semester of third B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

8. (a) A candidate who after passing V and VI semester of third B.E. examination and has attended a regular courses of study in particular branch of Engineering for the seventh semester of final B.E. shall be

eligible of appearing at the seventh semester examination of final B.E. in that branch of study.

(b) Every candidate appearing for the seventh semester of final B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended a regular courses of study for the eighth semester of final B.E. and has also appeared in the seventh semester examination of final B.E. shall be eligible for appearing at the eighth semester examination of final B.E. in that branch of study.

(d) Every candidate appearing for the eighth semester of final B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

9. Every candidate is required to undergo practical training in a workshop, factory, mine or engineering works/design office approved by the Dean of the Faculty for a period as mentioned below:

(a) Civil Engineering- after II and III Year 40+60=100 days

(b) Chemical Engineering- after II and III Year 40+60= 100 days

(c) Computer Science & Engineering after II and III Year 40+60= 100 days

(d) Electrical Engineering- after II and III Year 40+60=100 days

(e) Electronics & Comm. Engineering after II and III Year 40+60=100 days

(f) Mechanical Engineering- after II and III Year 40+60=100 days

(g) Mining Engineering- after II and III Year 40+60=100 days

(h) Production & Industrial Engineering after II and III Year 40+60=100 days

(i) Information Technology- after II and III Year 40+60=100 days

10. (i) The candidate has to pass individually in all subjects of each semester from III to VIII semesters. The result of I, III, V and VII semester shall be declared without awarding the division. The division will be awarded on the basis of combined performance of I & II semesters, III & IV semesters, V & VI semesters and VII & VIII semesters respectively.

(ii) For a candidate to pass in each semester he/she must obtain -

(a) 35 percent marks in each written paper.

(b) 50 percent marks in each of the practicals & sessionals (Combined).

(c) 45 percent in the grand total of the semester.

(iii) For written papers of First B.E. examination combined marks

obtained in I & II semester shall be counted for applying clause 10 (ii) (a).

(iv) For first B.E. examination if a candidate fails in not more than 3 units he/she shall be allowed to keep term (ATKT) in the next higher i.e. third semester. For the purpose of this clause each theory paper (Part I & Part II taken together) and each practical and sessional shall be counted as one unit.

He/She shall be required to appear in the ATKT exams in that unit(s) along with third semester examinations. Candidate failing in English/Social Sciences shall be awarded an additional ATKT.

(v) For III to VII semester examinations, if a candidate fails in not more than three units in a semester examination he/she shall be allowed to keep term (ATKT) in the next higher semester, subject to the provision of clause 6(c), 7(c) and 8(c). He/She shall appear in those unit(s) alongwith regular candidates whenever examination of that semester is held and pass in the unit(s) in which he/she has failed. For the purpose of this clause, each written paper and each practical and sessional of a semester shall be counted as a separate unit.

NOTE : A candidate who is unable to appear at the semester examination in some papers, Practical and sessionals due to any reason what so ever, shall be considered as having failed in those paper(s), Practical(s) and Sessional(s).

11. No candidate shall be permitted to pursue a regular course of study of Fourth B.E. (VII and VIII semesters) unless he/she has passed all the units of First B.E. examination. However, the unit of English/Social Science of First B.E. is exempted for this purpose.

12. Ex-student :

(i) For II, III and Final B.E. if a candidate fails in more than 3 units in a semester examination, he/she shall be declared as failed in that semester. For First B.E., if a candidate fails in more than 3 units (excluding English/Social Science) he/she shall be declared failed.

(ii) If a candidate fails in either of the semester or both semesters of a particular year (III and IV semester of II B.E, V and VI semester of III B.E. and VII and VIII semester of IV B.E.) he/she shall be declared failed in that year. Such candidate shall have to pursue his/her study as a regular student as per following clause(s):-

(a) A candidate failed in both semesters of a year shall have to pursue his/her study as a regular student. For this purpose he/she will have to take admission as a regular student in the same year.

(b) A candidate failed in either semester will have to take admission as regular student in the semester in which he/she declared fail. The other semester, in which he/she is declared passed, shall be exempted from

repeating that semester and the marks of that semester shall be carried over.

(c) A candidate who has passed all practicals and sessionals and failed in more than 3 units of written papers in a semester shall appear in the semester examination as Ex-student in all written papers. His practical and sessional marks of the semester shall be carried over.

However, such an ex-student can apply for regular course of study in the semester(s) in which he/she has failed. Being a regular student he/she shall appear in all the examinations of theory, practical and sessionals.

(d) Where a candidate fails in Practical and Sessional and is given the benefit of ATKT as per clause 10(ii) and (iv), he/she may choose to attend laboratory/sessional classes and submit a revised laboratory record/sessional. Such a candidate shall have to pay Rs.1000/- for doing each practical and sessional during the semester.

13. A candidate may be permitted to change his/her branch of study after passing B.E. I Year, strictly on the basis of merit secured in B.E. I year examination (First and Second Semester examination taken together) depending upon the vacancies available in a particular branch of study which shall be determined as follows:

"The maximum strength of a branch should not increase by more than 10 percent of sanctioned strength and the minimum strength of a branch should not be decreased to less than 80 percent of the sanctioned strength".

The sanctioned strength of a branch shall be reckoned to the number of candidates who have been promoted to the second year (Third Semester).

14. Award of Division:

(a) First B.E. to Third B.E.

First Class	:	if a candidate secures a minimum of 60 percent
Second Class	:	if a candidate secures a minimum of 50 percent
Pass Class	:	if a candidate secures a minimum of 45 percent

(b) Final B.E.: for the declaration of Final B.E. result, marks shall be totalled up as follows:

First	B.E.	50% of the Marks secured
Second	B.E.	75% of the Marks secured
Third	B.E.	100% of the Marks secured
Final	B.E.	100% of the Marks secured

(c) For determining merit position of the candidates at the final year level the marks obtained by them in the second, third and final year as described above shall only be considered.

(d) A candidate shall be awarded a degree with Honours if she/he secures a minimum of 70 per cent of aggregate marks. A candidate shall be awarded a degree with first class if she/he secures a minimum of 60 per cent of aggregate marks. A candidate shall be awarded a degree with second class if she/he secures a minimum of 50 per cent of aggregate marks. The rest of the successful candidates will be awarded pass class.

15. Requirement of additional degree:

(a) An engineering graduate of the Jai Narain Vyas University, Jodhpur who wishes to qualify for an additional degree of Engineering of the University will be considered by a committee consisting of the Dean and the Head of the Department concerned.

(b) He/She will be admitted in Third B.E. class of that branch. The papers and practicals and sessionals which he/she has to appear at the various examination in that branch will be decided by the above committee.

(c) He/She will be awarded division as follows:

(i) 100 per cent of marks of the papers and practical and Sessionals and Project if any, in which he/she appears for Third B.E.

(ii) and 100 per cent of the papers and Practical and Sessionals and Project if any, in which he/she appears for Final Year.

(d) His/her marks for the training which he/she has undergone after Third B.E.

He/She will be awarded division in Final year as per regulation.

He/She will not be awarded any position in the class.

(e) Mention will be made in the certificate that he/she has qualified for the additional degree.

16. The medium of Instructions and Examination in all Engineering Examinations of Theory/Practical and Sessionals, shall continue to be English as hitherto.

17. Make up Examination for VIII Semester:

(a) There shall be a Make up Examination for the VIII Semester only for those candidates who are eligible for ATKT in VIII semester, at a suitable interval of time after declaration of the result of the VIII Semester Examination. Candidates, who fail or are unable to appear at this Examination, shall appear in the immediate corresponding ensuing Semester Examination.

(b) Candidates who have failed in the Final B.E. Examination but have passed in project, practical training and tour, and obtained 45 percent in the grand total, shall be exempted from re-examination in project,

practical training and tour and shall be required to pass the examination in the rest of the subjects only.

(c) A candidate who passes in a limited number of Theory papers/Practical and Sessionals/Project in VIII Semester Examination shall be awarded division with a mention of "Pass in more than one attempt" on the mark sheet with asterisks on the respective Theory papers / Practical and Sessionals / Project.

18. For diploma passed candidates admitted to B.E.:

(a) The diploma passed candidates admitted in the Second B.E. (all branches) shall be required to undergo a regular course of study in Special Mathematics III and IV semesters of II B.E. alongwith other theory units of the semester examinations. For a candidate to pass in Special Mathematics examination the combined marks obtained in III & IV Semester shall be counted. Candidate failing in special mathematics shall be awarded one additional ATKT.

(b) No candidate of this category shall be permitted for regular course of study in Final B.E. unless he/she has passed the special Mathematics paper.

19.*For B.Sc Passed Candidates admitted to B.E. :

(a) The Students admitted under mentioned category will have to clear deficiencies of Engineering subjects (theory and Practical) of B.E. Ist year as mentioned below :-

Theory :

(i) Mechanical Engineering

(ii) Civil Engineering

(iii) Computer Science & Engineering

(iv) Electrical Engg.

(v) Electronics & Communication Engg.

Practicals :

(i) Machine Drawing (ii) Workshop

(iii) Practical Geomatry (iv) Civil Engineering

(v) Computer Laboratory (vi) Electrical Laboratory

(vii) Electronics & Comm. Lab.

(b) No candidate of this category shall be permitted for regular course of study in Final B.E. unless he/she has passed all above mentioned papers in 19 (a).

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

LIST OF TEACHING STAFF

ASSOCIATE PROFESSORS

1.	Dr. Vikas Kapoor HOD	B.E., M.E., Ph.D., MISTE, MIE
2.	Dr.Arvind Kumar Verma	B.E., M.E., Ph.D., MISTE
3.	Dr. Manish Kumar	B.E. (Hons), M.E., Ph.D., MISTE, MIE
4.	Dr. Milind Kumar Sharma	B.E., M.E. (Hons.), Ph.D.

ASSISTANT PROFESSOR

5.	Mrs. Rama Mehra	B.E. MISTE

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE II (P&I) 2015 **Semester III Examination Scheme**

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Exam Hrs.	Theory	Marks: Practicals & Sessionals	Marks: Total
	A. Written Papers										
PI 201A	Mechanics of Machine Tool Elements (PI)	2	1	-	3	2½	½	3	50	-	50
PI 202A	Manufacturing Technology I (PI)	2	1	-	3	2½	½	3	50	-	50
PI 203A	Material Science (PI)	3	1	-	4	3½	1	3	100	-	100
PI 204A	Mechatronics (PI)	2	1	-	3	2½	½	3	50	-	50
PI 205A	Theory of Machines (PI)	3	1	-	4	3½	1	3	100	-	100
EE 206A	Electrical Technology (PI)	2	1	-	3	2½	½	3	50	-	50
	Total (A)	14	6	-	20	17	4	-	400	-	400
	B. Practicals & Sessionals										
PI 221B	Drawing of Machine Tool Components and Assemblies I (PI)	-	-	3	3	1½	½	3	-	50	50
PI 222B	Workshop Practice I (PI)	-	-	3	3	1½	½	3	-	50	50
EE 223B	Electrical Technology Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
SE 224B	Material Testing Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
	Total (B)	-	-	12	12	6	2	-	-	200	200
	Grand Total (A+B)	14	6	12	32	23	6	-	400	200	600
FE 225 E	**Co-curricular Activities**	-	2	-	2	1	½	-	-	-	-

For a pass, a candidate must obtain:
(a)35 per cent in each written paper,
(b)50 per cent in each of the practicals and sessionals
(c)45 per cent in aggregate

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE II (P&I) 2015 **Semester IV Examination Scheme**

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Exam Hrs.	Theory	Marks: Practicals & Sessionals	Marks: Total
	A. Written Papers										
PI 251A	Analysis & Design of Components (PI)	1	1	-	2	1½	½	3	50	-	50
PI 252A	Computer Oriented Numerical Analysis (PI)	2	1	-	3	2½	½	3	50	-	50
PI 253A	Engineering Economics (PI)	2	1	-	3	2½	½	3	50	-	50
PI 254A	Manufacturing Technology II (PI)	2	1	-	3	2½	½	3	50	-	50
MA 255A	Engineering Mathematics & Statistics (PI)	3	1	-	4	3½	1	3	100	-	100
ME 256A	Fluid Engineering and Heat Transfer (PI)	2	1	-	3	2½	½	3	50	-	50
	Total (A)	12	6	-	18	15	3½	-	350	-	350
	B. Practicals & Sessionals										
PI 261B	Analysis and Design of Components (PI)	-	-	3	3	1½	½	3	-	50	50
PI 262B	Computer Applications to Production & Industrial Engineering (PI)	-	-	2	2	1	½	3	-	50	50
PI 263B	Drawing of Machine Tool Components and Assemblies II (PI)	-	-	3	3	1½	½	3	-	50	50
PI 264B	Workshop Practice II (PI)	-	-	3	3	1½	½	3	-	50	50
ME 265B	Fluid Engineering and Heat Transfer Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
	Total (B)	-	-	14	14	7	2½	-	-	250	250
	Grand Total (A + B)	12	6	14	32	22	6		350	250	600
	Total of III & IV Semester	-	-	-	-	-	12	-	-	-	1200
FE 266 E	**Co-curricular Activities***	-	2	-	2	1	½	-	-	100	100

* Joint Award for III & IV Semester. (Marks not counted for award of Division / Degree).
For a pass, a candidate must obtain:
(a)35 per cent in each written paper, (b)50 per cent in each of the practicals and sessionals (c)45 per cent in aggregate

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE III (P&I) 2016 **Semester V Examination Scheme**

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Exam Hrs.	Theory	Marks: Practicals & Sessionals	Marks: Total
	A. Written Papers										
PI 301A	Design of Machine Tool Components & Assemblies (PI)	2	1	-	3	2½	½	3	50	-	50
PI 302A	Operations Research (PI)	3	1	-	4	3½	1	3	100	-	100
PI 303A	Work Study & Ergonomics (PI)	2	1	-	3	2½	½	3	50	-	50
PI 304A	Principles of Management & Economics (PI)	3	1	-	4	3½	1	3	100	-	100
PI 305A	Production Processes I (PI)	2	1	-	3	2½	½	3	50	-	50
ME 306A	Thermal Engineering (PI)	2	1	-	3	2½	½	3	50	-	50
	Total (A)	14	6	-	20	17	4	-	400	-	400
	B. Practicals & Sessionals										
PI 331B	Computer Aided Design Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
PI 332B	Design of Machine Tool Components & Assemblies (PI)	-	-	3	3	1½	½	3	-	50	50
PI 333B	Production Engineering Laboratory I (PI)	-	-	3	3	1½	½	3	-	50	50
ME 334B	Thermal Engineering Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
	Total (B)	-	-	12	12	6	2	-	-	200	200
	Grand Total (A + B)	14	6	12	32	23	6		400	200	600
FE335 E	**Co-curricular Activities**	-	2	-	2	1	½	-	-	-	-

For a pass, a candidate must obtain:
(a)35 per cent in each written paper,
(b)50 per cent in each of the practicals and sessionals
(c)45 per cent in aggregate

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE III (P&I) 2016 **Semester VI Examination Scheme**

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Exam Hrs.	Theory	Marks: Practicals & Sessionals	Marks: Total
	A. Written Papers										
PI 351A	Engineering Metrology (PI)	2	1	-	3	2½	½	3	50	-	50
PI 352A	Plant Engineering (PI)	3	1	-	4	3½	1	3	100	-	100
PI 353A	Measurement Systems (PI)	2	2	-	4	3	½	3	50	-	50
PI 354A	Production Processes II (PI)	2	1	-	3	2½	½	3	50	-	50
PI 355A	Production & Operations Management I (PI)	2	1	-	3	2½	½	3	50	-	50
PI 356A	Quality Management (PI)	3	1	-	4	3½	1	3	100	-	100
	Total (A)	14	7	-	21	17½	4	-	400	-	400
	B. Practicals & Sessionals										
PI 361B	Entrepreneurship Development (PI)	-	-	2	2	1	½	3	-	50	50
PI 362B	Industrial Engineering Laboratory I (PI)	-	-	3	3	1½	½	3	-	50	50
PI 363B	Production Engineering Laboratory II (PI)	-	-	3	3	1½	½	3	-	50	50
PI 364B	Process Instrumentation & Control Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
	Total (B)	-	-	11	11	5½	2	-	-	200	200
	Grand Total	14	7	11	32	23	6	-	400	200	600
FE365 E	**Co-curricular Activities***	-	2	-	2	1	½	-	-	100	100

* Joint Award for III & IV Semester. (Marks not counted for award of Division / Degree).
For a pass, a candidate must obtain:
(a)35 per cent in each written paper, (b)50 per cent in each of the practicals and sessionals (c)45 per cent in aggregate

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE IV (P&I) 2017

Semester VII Examination Scheme

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Exam Hrs.	Theory	Marks: Practicals & Sessionals	Marks: Total
	A. Written Papers										
PI 401A	Automation & Computer Aided Manufacturing (PI)	4	1	-	5	3½	1	3	100	-	100
PI 402A	Production Processes III (PI)	4	1	-	5	4½	1	3	100	-	100
PI 403A	Production & Operations Management II (PI)	2	1	-	3	2½	½	3	50	-	50
PI 404A	Tool Design I (PI)	3	1	-	4	2½	½	3	50	-	50
PI 405A	Productivity Engineering (PI)	2	1	-	3	2½	½	3	50	-	50
	Total (A)	15	5	-	20	15½	3½	-	350	-	350
	B. Practicals & Sessionals										
PI 441B	Computer Aided Machining Laboratory I (PI)	-	-	3	3	1½	½	3	-	50	50
PI 442B	Production Engineering Laboratory III (PI)	-	-	3	3	1½	½	3	-	50	50
PI 443B	Industrial Engineering Laboratory II (PI)	-	-	3	3	1½	½	3	-	50	50
PI 444B	Seminar (PI)	-	-	3	3	1½	½	3	-	100	100
	Total (B)	-	-	12	12	6	2	-	-	250	250
	Grand Total (A + B)	15	5	12	32	21½	5½	-	350	250	600
FE445 E	**Co-curricular Activities**	-	2	-	2	1	½	-	-	-	-

For a pass, a candidate must obtain:

(a)35 per cent in each written paper,

(b)50 per cent in each of the practicals and sessionals

(c)45 per cent in aggregate

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ENGINEERING

BE IV (P&I) 2017

Semester VIII Examination Scheme

Subject Code	Subject	Lecture	Tutorial	Practical	Contact Hrs.	Credits	Units	Ex. Hrs.	Marks: Theory	Marks: Practical & Sessionals	Marks: Total
	A. Written Papers										
PI **	Elective I (PI)	3	2	-	5	4	½	3	75	-	75
PI **	Elective II (PI)	3	2	-	5	4	½	3	75	-	75
PI 467A	Tool Design II (PI)	3	1	-	4	4	½	3	50	-	50
PI 468A	Production Process IV(PI)	2	1	-	3	4	½	3	50	-	50
PI 469 A	Supply Chain Management (PI)	2	1	-	3	4	½	3	50	-	50
	Total (A)	**13**	**7**	**-**	**20**	**20**	**2½**	**-**	**300**	**-**	**300**
	B. Practicals & Sessionals										
PI 470B	Industrial Engineering Laboratory III (PI)	-	-	3	3	1½	½	3	-	50	50
PI 471B	Product Design Laboratory (PI)	-	-	3	3	1½	½	3	-	50	50
PI 472B	Production Engineering Laboratory IV (PI)	-	-	3	3	1½	½	3	-	50	50
PI 473B	Computer Aided Manufacturing Laboratory II (PI)	-	-	3	3	1½	½	3	-	50	50
	Total (B)	**-**	**-**	**12**	**12**	**06**	**2**	**-**	**-**	**200**	**200**
	C. Practical Training & Tour										
	Practical Training (PI)	-	-	-	-	-	1	-	-	75	75
	Educational Tour (PI)	-	-	-	-	-	-	-	-	25	25
	Total (C)	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**100**	**100**
	D. Project										
	Project (PI)	-	-	3	3	-	2	-	-	150	150
	Total (D)	**-**	**-**	**3**	**3**	**-**	**2**	**-**	**-**	**150**	**150**
	Grand Total (A+B+C+D)	**13**	**7**	**15**	**35**	**26**	**7½**		**300**	**450**	**750**
FE473 E	**Co-curricular Activities***	**-**	**2**	**-**	**2**	**1**	**½**	**-**	**-**	**100**	**100**

*** Joint Award for VII & VIII Semester. (Marks not counted for award of Division / Degree).**

**** Students have to opt Elective I and Elective II from the common list of Elective.**

List of Papers in Elective

(a) PI 451A Marketing and Financial Management

(b) PI 452A Modern Machining Methods

(c) PI 453A Welding Engineering

(d) PI 454A Foundry Engineering

(e) PI 455A Computer Aided Design

(f) PI 456A Robotics & Soft Computing

(g) PI 457A Computer Aided Process Planning

(h) PI 458A Simulation

(i) PI 459A Finite Element Method

(j) PI 460A Operations Research II

(k) PI 461A System Engineering

(l) PI 462A Productivity Management

(m) PI 463A Personnel Management and Industrial Relations

(n) PI 464A Management Information System

(o) PI 465A Supply Chain Management

(p) PI 466A Intellectual Property Rights

For a pass, a candidate must obtain:

(a) 35 per cent in each written paper,

(b) 50 per cent in each of the practicals and sessionals

(c) 45 per cent in aggregate

BE II (P&I) 2015 EXAMINATION

SEMESTER III

PI 201A ENGINEERING MECHANICS (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

1. Stress and Strain- Simple and Compound Stresses, Temperature stress and composite bars, elastic and plastic behaviour of machine elements in tensile and compressive tests, characteristic stress-strain curve, Ultimate strength, working stress and factor of safety, Resilience and suddenly applied loads.

2. Advanced concepts in SFD & BMD: Non uniformly distributed loads, Relation between load, shear force & bending moment. Deriving Sharing Force Diagram and load diagram from Bending Moment Diagram.

3. Theory of simple bending, distribution of normal stress in beams due to bending, section modulus. Shear stress distribution in rectangular, circular, 'T', 'L' and 'I' sections.

4. Deflection in beams: Slope and deflection of cantilever and simply supported beams by Macaulay's, conjugate beam and area moment methods.

5. Principal planes, stresses and strains, Mohr's circle diagram for 2D stresses, Theories of elastic failure.

6. Torsion: Shear stress in solid and hollow circular shaft, angle of twist, power transmitted by a shaft under pure torsion, Combined axial, bending and torsion stresses. Stress and deflection of machine members such as close coiled circular section helical springs, spindles & shafts.

7. Thin cylinders and shells, stresses and strains in thin cylindrical and spherical shells.

8. Columns: Long and short columns, axial and eccentric loading, ideal strut, Euler's formula for crippling load, end conditions straight line formula.

PI 202A MANUFACTURING TECHNOLOGY I (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Foundry: Types of pattern and pattern allowances; Moulding materials, ingredients of moulding sand, additives, Moulding sand properties and their testing, Moulding and casting methods, Green, dry and loam sand methods, floor and pit methods, core making and core materials, chaplets and chills, external and internal chills, shell moulding, Investment moulding, Metal mould casting; gravity feed and die casting; full mould casting, centrifugal casting; ceramic mould casting, continuous casting, fettling, cleaning and inspection of casting; Principles of gating and risering design, casting defects and their remedies principles of casting design. Construction and operation of cupola furnace, Mechanization in foundries; sand reclamation.

Press Working: Classification of presses, Press operations, shearing, bending, forming and drawing operations and dies, compound and progressive dies; stretch forming and deep drawing; High energy rate forming.

PI 203A MATERIAL SCIENCE (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Strengthening Mechanisms: Effect of grain size, strain hardening, strain aging and dispersion hardening. Recovery, recrystallization and grain growth. Introduction to fracture mechanics: critical flow size, Griffth theory of fracture, Plain strain fracture, toughness, brittle and ductile fracture, Impact test, Hardness and its measurement, Brinell, Rock-well, Vickers and Knoop test.

Equilibrium Diagrams: Solidification of pure metals and alloys, Construction of phase diagram, eutectic, eutectoid and peritectic reactions and alloy systems. Iron-Carbon equilibrium diagram.

Heat Treatment: Phase transformation in steel, transformations in heating and cooling, critical temperatures, T-T-T diagram Hardening critical cooling rate, hardness and hardenability. Jommy End quench test, Annealing methods.

Normalizing, Hardening and Tempering, Surface and case Hardening Methods: Carburizing, Nitriding and cynading methods, Induction and Flame Hardening, Heat treatment furnaces: batch and continuous

type, Control of atmosphere in furnace. Effects of alloying elements in steel. Defects in heat treatments (Warpage overheating, burning etc.) and their control.

Ferrous Materials: Manufacture of pig iron, Blast furnace Cast irons. Gray, white, malleable and spheroidal. Graphite cast irons. Heat treatment of cast irons, Brief out lines of the manufacturing of steel open hearth. Bessmer, L.D. and Electric processes, Plain carbon steels, Alloy steels, stainless steels, wear resistance, heat resistant spring and high strength steels; Tool steels and their heat treatment.

Nonferrous Metal: Composition, properties and application of aluminium and its alloys; copper and its alloys, Bearing materials.

Non-metallic Materials: Refractories, Engineering ceramics and cermets, Introduction to Industrial Plastics and composites.

PI 204A MECHATRONICS (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

1. Definitions of Mechatronics, the Mechatronics design process, introduction to Mechatronics systems and components.

2. Basic electronics: Basic logic circuits, logic gates and truth table, combinatorial logic, Boolean algebra, flip flops-SR, D, and JK. Binary arithmetic and BCD. Half and Full adder circuit. Counters and shift registers. AD and DA converters.

3. Microprocessor: Introduction to 8085 microprocessor, its instruction format and simple assembly programs. Introduction of PLC.

4. Introduction to digital sensors for length, speed and acceleration. Encoders, resolvers.

5. Electromechanical control: Introduction to stepper motors and servomotors. Their operating mechanism and circuits.

6. Actuators: introduction to Solenoid actuators, Hydraulic actuators and pneumatic actuators.

PI 205A THEORY OF MACHINES (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Analysis of Machine Tool Mechanism: Definitions of Links, Mechanisms, Inversions and Machines, Kinematic Chains, Analysis of four bar kinematic chains and slider crank chains, Velocity and Acceleration analysis using relative velocity method,instantantaneous

centre method, analytical method with special emphasis on coriollis acceleration.

Force Analysis: Concept of free body and its equilibgrium, Transmission of forces in Machine Tools: Quick return mechanism, slider crank mechanism, four bar linkage, Inertia force analysis.

Cams: Types of cams and followers, cam profile development from given type of motion, force analysis and velocity, acceleration analysis for given cam

Gears: Definitions, Classification. Laws of Gearing, Basis Terminology, Generation of tooth profile: Involute and Cycloidal. Interference, Backlash and their removal. Spur, helical, spiral, bevel and worm gears, Gear Trains, Simple, compound and epicyclic gear trains.

Introduction to Systems with single degree of freedom for damped & undamped Vibrations.

EE 206 A ELECTRICAL TECHNOLOGY (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

D.C. Machines: Characteristic Curves of D.C. Generators and Motors. Application of motors for different uses, Starting and speed control of motors.

Induction Motor: Polyphase induction motors-starters, equivalent circuit, effect of rotor resistance, torque-slip curves, speed control by rotor resistance, pole changing and cascading, use in industry, Single phase induction motor-starting method.

Alternators: Elementary idea of armature winding Calculation of induced e.m.f., factors affecting generating e.m.f., open circuit, short circuit and load characteristics. Voltage regulation and its determination by synchronous impedance method, synchronizing.

Synchronous Motors: Methods of starting, power angle characteristics of cylindrical rotor machine, operation of synchronous motors as condenser and as a reactor. Application in industries.

Transformers: Equivalent Circuit, Phaser diagram, efficiency, Regulation, Open circuit and short circuit tests.

Selection of electrical drivers: Factor to be considered, selection of power rating for drive motor based on thermal limits, overload capacity and load variation factors.

SEMESTER IV

PI 251 A ANALYSIS AND DESIGN OF COMPONENTS (PI)

Credit 1½, 1L, 1T 3 hours, 50 Marks

Design: Definition and significance, Design Process, General Procedure for analysis of problems. Introduction to various design aspects. Manufacturing consideration in Machine Design.

Design for Strength: Types of load; failure criteria; Factor of safety. Allowable stress. Stress concentration and Prevention. Endurance limit and fatigue failure.

Design of Machine Elements Subjected to Direct Stress: Cotter pin and knuckle joints.

Design of riveted joints, Screw fastenings and welded joints.

Design of Members in Bending: Theory of bending of straight beams, Bending stress and shear stress distribution in beams, Shear force and Bending moment diagrams.

Deflection and Stiffness: Relationship between bending moment slope and deflection. Computation for deflection of beams under simple loading. Design of Beams, levers and laminated springs.

Design of Members Subjected to Combined Loading: Axial, bending and torsion. Concept of Principle stresses and planes. Selection and classification of keys and couplings for various shaft usages. Theories of failure.

Design of Eccentrically loaded components and joints.

PI 252 A COMPUTER ORIENTED NUMERICAL ANALYSIS (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

1. Solution of Algebraic Equations: Bisection method, iteration method, false position method, Newton-Raphson method.

2. Linear System of Equations: Matrix inversion method, Gaussian elimination method, iterative method. Introduction to Eigenvalue.

3. Interpolation: Forward Finite difference, Backward Finite difference, Central Finite difference, Newton's formulae of interpolation, Lagrange's formula of interpolation, Sterling's interpolation formula.

4. Numerical Differentiation and Integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson 3/8 rule.

5. Numerical Solution of ordinary differential equations: Taylor series, Packard's successive approximation method, Euler's method, modified Euler's method, Runge Kutta forth order, Milne's method.

6. C programs of above techniques.

PI 253A ENGINEERING ECONOMICS (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Introduction: Engineering Economy & decisions among alternatives. The use of accounting costs in economy studies.

Element of Costing: Classification of costs, direct & indirect cost: Labour, Material & Overhead cost, prime cost, factory cost, Fixed & Variable costs

The Economic environment & cost concepts: Measures of Economic worth, cost volume relationships, the law of supply & demand, cost concept of economic analysis, opportunity costs, incremental cost, breakeven charts.

Interest & money time relationship: Simple charts, compound interest, equivalence, cash flow diagram, interest formulas for discrete compounding & discrete payments, interest formulas for relating present & future worth of single amounts, interest formulas relating a uniform series (Annuity) to its present & future worth. Equivalent present worth, future worth and annual worth.

Methods for making economy studies: Basic methods, the Annual worth method, calculation of capital recovery cost, the present worth method, the future worth methods, the internal rate of return method.

Depreciation & Valuation: Definition of Value, purpose of depreciation, types of depreciation, methods of computing depreciation.

Replacement studies: Reasons for replacement, replacement method.

PI 254A MANUFACTURING TECHNOLOGY II (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Gas Welding: Energy sources and equipment, welding joints and positions, Gas cutting principle and equipment.

Brazing and Soldering: Methods and materials, Braze Welding.

Electrical arc welding: Manual arc welding and submerged arc

welding, Nature of welding arc, voltage, polarity, current; Current sources of welding: AC and DC machines, characteristics and uses of constant current and constant potential machines, Duty cycle; welding electrodes, their classification and selection; Shield metal arc welding. Gas metal arc welding (MIG and MAG), fluxed cored arc welding, Gas tungsten arc Welding (TIG), Electroslag and electrogas welding, plasma arc welding, electron beam welding, laser beam welding.

Solid State Welding: Friction welding. Ultrasonic welding. Explosion welding. Thermit welding.

Resistance Welding: Principle, spot, seam and projection welding. Upset and flash butt welding. Thermal spraying, flame, electric and plasma spraying. Application of thermal spraying.

Nature of Weld: Heat affected zones, Defects in weldments: distortion, cracks and gas defects, concept of weldability.

NDT: Dye penetrant, magnetic particles, ultrasonic and radiographic methods.

Machine Tools: Elements of machine tools, Centre lathe and operations on it, capstan and turret lathes. Construction and operations, introduction to automatic lathes. Shapers, Planers and Slotters. Quick return mechanism. Drilling machines. Twist drill details. Radial, gang, multispindle and deep hole drilling machines. Boring operation, Horizontal, vertical and jig boring machines.

MA255A ENGINEERING MATHEMATICS & STATISTICS (PI)

Credits 3½, 3L, 1T 3 hours, 100 Marks

Integral transforms: Laplace transform, various theorems. Inverse Laplace transform, Applications to solutions of ordinary and simultaneous differential equations.

Special Functions: Solutions of Bessel and Legendre's differential equations, Bessel function and Legendre polynimal of first kind. Their generating functions, recurrence relations, orthogonality, Rodrigue's formulae, and other properties.

Differential Equations: Simultaneous differential equations, Total differential equation, Partial differential equation of the first order (Langrange's and Charpit's methods), Linear partial differential

equations with constant coefficients, Solution of Wave, Heat & Laplace equations (two dimensional) by separation of variables method.

Statistics: Concept of probability; Binomial, Poisson and normal distributions. Coefficient of correlation and lines of regression.

ME 256A FLUID ENGINEERING AND HEAT TRANSFER (PI)

Credits 2½, 2L, 1T 3 hours, 50 Marks

(A) FLUID MECHANICS

Basic Concept relating to fluids: Definitions- Fluid, incompressible and compressible fluids, Density, Relative density, viscosity, Kinematic viscosity, Newtonian and Non Newtonian fluids, effect of temperature and pressure on viscosity, Ideal fluid (Definition only).

Static pressure and its Management: Manometer's Problems, Total Pressure, centre of pressure.

Fluid Kinematics: Definitions of steady and unsteady flow, uniform and non uniform flow, Rotational and Irrotational flow, Streamline. Continuity equation. Circulation and vorticity.

Fluid Dynamics: Euler's equation of motion- Bernoullis equation, application of Bernoullis Equation- Venturimeter, Orfice meter, nozzle and pitot tube.

Momentum equation- application of the momentum equation.

Flow through pipes: Pipes in series and parallel.

Dimensional Analysis: Bukingham theorem. Force ratios, Model similitude. Types of model scale effect and model testing.

(B) HEAT TRANSFER

Introduction: Fouriers law conduction, Newton Rikman equation, Steafan Boltzman law, Overall heat transfer co-efficient.

Conduction: One dimensional heat flow equation in Cartesian coordinate. One-dimensional flow through composite tube, cylindrical spherical shell, Critical insulation.

Convection: Dimensional analysis of forced and free convection, empirical relations.

Convection with Phase change: Description of condensing flow, boiling heat transfer.

Heat exchanger: LMTD equation and its applications.

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SEMESTER V

PI 301A DESIGN OF MACHINE TOOL COMPONENTS & ASSEMBLIES (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Design of components subjected to compound stress: Line shafts Machine spindles mounted with pulleys, gears, fly wheels etc. Crank shafts with reference to machine tool applications such as punching press. Design of Connecting rods.

Design of Power Transmission System having Belt, Rope and Chain drives.

Design of Gear drives using spur and helical gears, Introduction to bevel and worm gear design. Design of clutches and brakes for Machine Tools.

Design of Bearings: Journal, Radial and Thrust bearings. Selection of ball and roller bearings for Machine Tool applications such as power press, fly wheel etc.

Pressure Vessels: Design of thick and thin cylinders. Hydraulic and pneumatic cylinders for machine tool application.

Introduction to Computer Aided Design: Concept of search algorithms, design data base and optimization in design problems.

PI 302A OPERATIONS RESEARCH (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Characteristics and scope of Operations Research, Formulation of problem and methodology of operations research.

Linear Programming: - Graphical and Simplex method. Application of LP to production allocation, Transportation and Assignment, Theory of Duality, and Detailed sensitivity analysis.

Queuing Models / Waiting Theory: Elementary concepts of queuing, Introduction to single server and multiserver model with special emphasis on (M/M/1: GD/∞/∞) & (M/M/C: GD/ ∞/∞).

Competitive Methods: Theory of Games and bidding models.

Inventory Models: Inventory control, deterministic and probabilistic inventory models.

Simulation: Introduction, Process of Simulation, Deterministic versus stochastic simulation, Monte Carlo Technique, Random number generation, scope of simulation applications.

PI 303 A WORK STUDY & ERGONOMICS (PI)

Credit 2½, 2L, 1T 3 Hours, 50 Marks

Definition, Scope and Historical Review; Work Methods Design-Process and Operational Analysis; Objectives and Areas of Application of Work Study in Industry; Human Aspects of Work Study, and Human Factors Engineering and Their Role in Productivity Improvement; Interrelation Between Method Study and Work Measurement.

Definition and Objectives of Method Study, Engineering Approaches to Methods Analysis and Improvement, Data Collecting and Recording Techniques; Critical Examination and Development, Creative Thinking, Installation and Maintenance of New/Improved Methods.

Principles of Motion Economy, Motion Analysis, Micromotion and Memomotion Study, Therbligs and SIMO Charts.

Principle and Technique of Work Sampling, Applications of Work Sampling Studies.

Definition and Objectives of Work Measurement, Techniques, Stop Watch Time Study, Principles and Procedures, Systems of Performance Rating, Allowances, Calculation of Basic Time. Allowances and Standard Time, Fatigue, Machine Interference.

Predetermined Motion and Time Standards (PMTS), Work Factor System, Method Time Measurements (MTM), Basic Motion Studies, Standard Data System.

Introduction of Ergonomics, Importance of Ergonomics in Equipment and Work Design; Concept of Man-Machine Systems, Types and Characteristics of Man-Machine Systems.

Significance of Human Body Measurement in Equipment Design; Static and Dynamic Anthropometry; Applications of Anthropometric Data in Work Place Design.

PI 304A PRINCIPLES OF MANAGEMENT & ECONOMICS (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Introduction: Historical developments, Functional area of business, need for their integration and development of business goals.

Types of Business Organisation: Sole proprietorship, Partnership, Private and Public Limited Companies, Co-operative societies, public sector and joint sector, their formation and dissolution.

Management: Principles of Management, Elements of Management i.e. Planning, Organising, Staffing, Directing, Co-ordinating and Control.

Internal Organization: Line, Functional, Line and Staff, committee form of organization; Organisational and Responsibility flow in Organisation.

Personnel Management: Organisation, functions and responsibilities, relationship with other departments.

Basic Concepts of Economic Analysis: Marginal analysis; Concept of Time perspective; Discounting concept; The equilibrium concept.

Demand Analysis: Laws of demand and supply, Demand curves and demand function, Relation of demand to price, Demand elasticity; Demand precasting.

Theory of Production: Production function; Economies of scale.

Budget and Budgetary Control: Types of budget, Preparation of budget, standard cost and variation.

Financial Analysis: Money time relationship, Profit and interest, Ratio analysis, Analysis of operating and financial leverage.

Financial Statement: Manufacturing account: Profit and Loss Account, Balance Sheet, Analysis of Financial Statement.

PI 305A PRODUCTION PROCESS-I (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Powder Metallurgy: Production of powders, powder characteristics, particle-shape and size, brequetting, sintering and finishing, Production of complex shapes. Application of Powder metallurgy in bearings, tungsten filaments and cemented carbides etc.

Metal Cutting Principles: Theory of chip formation and flow of chip,

Geometry of single point cutting tools, Designation of Single Point Tool. Geometry of milling cutters, broaches and twist drills. Velocity, forces and power consumption in orthogonal cutting. Cutting Ratio, Shear angle, Shear strain and strain rate, elements of oblique cutting, specific cutting energy, friction and thermal aspects, Mechanism of tool wear and tool life, surface finish, effect of cutting parameters, machinability, economics of machining, cutting tool materials, cutting fluids and their application.

ME 306A THERMAL ENGINEERING (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Steam Nozzles: Steam flow through nozzles, Design of throat and exit areas. Effect of variation of back pressure.

Steam Turbines: Types and classification, Methods of reducing rotor speed. Velocity diagrams and various efficiencies, condition for maximum out put. Regenerative feed heating and bleeding. Reheat factor, Governing.

IC Engines: Deviation from ideal cycle and various losses, various stages of combustion in S.I. and C.I. engines, Detonation and knocking, IC Engine fuels and their ratings, Performance and testing of Engines, various efficiencies, heat balance sheet.

Rotary Compressors and Gas Turbines: Centrifugal and axial flow compressors determination of various dimensions and power input, simple gas turbine cycle, heat exchanger, intercooling and reheating

Power Plant Engineering: Principal types of power plants. Layout and their working, Non-conventional energy sources, solar, wind and biomass etc.

Refrigeration and Air Conditioning: Air refrigeration and its application to air craft air conditioning. Vapour compression and vapour absorption cycles, use of PH chart, Introduction to steam jet and thermo electric refrigeration. Air Conditioning and use of Psychrometric charts, Introduction to comfort air conditioning.

SEMESTER VI

PI 351A ENGINEERING METROLOGY (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Introduction to Metrological Concepts: Accuracy and Precision of Measurement, Sensitivity, Reliability, Standards of measurements, errors in measurement. Linear Measurement. Design of Limit Gauges, Taylor's principle. Comparators (Mechanical, Electrical, Optical and Pneumatic), Slip Gauges, Angle Measurement.

Measurement of Surface Finish: Direct and Indirect methods, Term and definitions used in roughness, KMS, and CIA profilometer, the emlinson surface meter, light sources for interferometry, flatness and parallelism measurement.

Metrology of Screw Threads: Screw thread terminology, measurement of major, minor and effective diameters best wire size, two and three wire methods, pitch measurement and thread gauges.

Gear Metrology: Spur gear measurement, Runout checking with concentricity tester, pitch measurement, profile errors, composite errors with gear tool tester, some recent electronic and optical development in gear measurements.

Machine Tool Metrology: Instruments required for alignment test, general alignment tests for Lathes. Milling and Drilling machines. Special Machines: Universal Measuring Machines, Computer Controlled Co-ordinate Measuring Machines.

PI 352A PLANT ENGINEERING (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Plant Location: Factors affecting plant location and site selection, Procedure for location and site selection.

Plant Layout: Types of plant layout, Process and Product Layout, Type of production activities: Job shop, Mass production, similar products and special products manufacturing and their influence on Plant Layout.

Layout Fundamentals: Information necessary for Layout planning, Factors affecting plant layout : Man, Material, Machinery, Building, Service and Safety.

Layout Development: Collection of information, Flow analysis, Process charts, multi-product charts, assembly charts and flow

diagrams. Layout development aids: Templates, models etc. Evaluation of layout.

Computer assisted Layout Development: Introduction to Modern Layout Development, Computer Programmes such as CRAFT, CORELAP, ALDEP etc.

Installing the Layout: Procedure, Plant Engineering and acceptance.

Material Handling: Principles of material handling, its relationship with plant layout, safety in operation, different types of material handling equipments, their suitability and uses. Replacement models with special emphasis on material handling equipment and their obsolescence.

Introduction to Plant Maintenance: Tools & Techniques: Signature Analysis: Vibration parameters, Data Interpretation, Lubricant Oil Examination, Contaminant Analysis, SOAP, On-line Condition Monitoring Techniques, Magnetic Chip Detectors and their use in Maintenance.

PI 353A MEASUREMENT SYSTEMS (PI)

Credit 3, 2L, 2T 3 Hours, 50 Marks

Introduction: Monitoring and operations. Functional elements of an instrument. Active and passive transducers. Analog and digital modes of operation, null and deflection method. Calibration, accuracy, precision & bias sensitivity, linearity, threshold, resolution and dead space. Scale reliability, span.

Pressure Measuring: Transducers, Direct and Indirect Acting, Elastic Type-Strain Gauge, Pressure Cell and Electric Resistance Pressure Cells.

Displacement Measurements: Measurement, LVDT and its Applications, Principles of Angular Velocity, Measurement and Accelerometer.

Flow Measuring Transducer: Variable Area Meters, Magnetic Flow Meters, Strain Gauge Flow Meters, Ultra Sonic Flow Detector.

Temperature Measurements: Bimetal Thermometers, Pressure Thermometers Thermo-Couple, Optical and Radiation Pyrometers and Remote Temperature Measurement, Temperature Measurement of Liquid Metal.

Measurement of Force and Torque: Elastic Transducers, Strain Gauge Load Cell, Mechanical and Hydraulic Dynamometers, Machining Dynamometers.

Vibration Measurements: Vibrometers, Vibration Pick-ups for Machine Tool, Accelerometer, Seismic Instruments.

Telemetering Devices and Display Units: X Y Z and X,-Y Recorders, Single and Multi Point Recorders, Indicating and Digital Instruments, Principles of CRO and VTVM.

PI 354A PRODUCTION PROCESSES II (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Machine Tools: Milling process, construction and operation of horizontal, vertical and universal milling machines. Introduction to special milling machines. Milling cutters, Indexing head and indexing methods, Broaching, types of broaches, Broaching machines : horizontal, vertical, surface and continuous broaching machines, Grinding machines, surface, cylindrical and centreless grinders (external and internal), Tool and cutter grinding. Grinding wheels, balancing of grinding wheels, dressing and turning operations, elements of grinding wheels, selection of grinding wheels.

Production of Screw Threads, Shafts and Gears: Screw thread chasing, rolling, die threading and tapping. Thread milling, thread grinding characteristics of small diameter and heavy shafts, Manufacture of shaft type machine elements; Gear materials, casting stamping and rolling, Gear milling, Gear generation, Gear shaving and hobbing, Bevel Gear Manufacture; Gear finishing shaving, grinding and lapping etc.

Semi automatic and automatic turning machine, special tools and attachments for these machines, operation planning, tool layout and cam design for single spindle automatic machines.

PI 355A PRODUCTION & OPERATIONS MANAGEMENT I (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Documentation of the Production & Operations Management Department Organizational Chart, Historical development of Operations Management.

Production Planning: Type of production and their basic

Characteristics Continuous, intermittent and job order type, comparison of process alternatives.

Operation Scheduling: Different methods of machine loading and scheduling, master scheduling, line balancing, batch sizing, aggregate production planning, job shop scheduling terminology, comparison of various sequencing rules, Introduction to sequencing theory for a single machine, sequencing algorithms for multiple machines.

Forecasting: Objective of sales forecasting, various techniques of sales forecasting: forecasting qualitative models, causal and time series models, moving average, exponential smoothing, regression and correlation methods. Long, medium and short range forecasting.

Planning: Product analysis, make and buy decisions, process planning and preparation of bill of materials and route sheets.

PI 356A QUALITY MANAGEMENT (PI)

Credit 3½, 3L, 1T 3 hours, 100 Marks

Quality Control: Meaning of quality and need of quality control, Assignable and non-assignable causes of variation, normal curve and other frequency distributions. Need of SQC, Statistical tolerances.

Statistical methods for Quality Control in Manufacturing: An introduction to statistics for Quality applications, Process capability, Theory of control charts, control limits and specification limits; Control charts for variable. $\bar{x}$, R charts, control charts for attributes, p, np charts, c-charts and u-charts. Study of special control charts; Moving range and moving average charts, CUSUM charts.

Acceptance sampling : Some fundamental concepts in acceptance sampling, O.C. curve, sampling terms, sampling plans with different criteria.

Quality Management : Introduction to Total Quality Control, Total Quality Management, Quality Assurance, ISO-9000, Quality Control tools, Kaizen, Benchmarking, cost of poor quality, Philosophies of Quality gurus like W.E. Deming, J.M. Juran, K. Ishikawa and Philip B. Crosby.

Reliability : Basic concept, definition and it's importance, Measures of Reliability, System Reliability : Series, Parallel systems.

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SEMESTER VII

PI 401A AUTOMATION & COMPUTER AIDED MANUFACTURING (PI)

Credit 3½, 4L, 1T 3 hours, 100 Marks

Basic Principle of Mechanization, Automation and Automatic Controls, Open and Close Loop System, Adaptive control, Hydraulic, Pneumatic and Electro-mechanical actuating systems, Position and Velocity Feed back systems; Transfer function and Introduction to Mathematics of Control System. Sensitivity and Stability. Transfer lines, Automatic feeding system.

Classification of NC Systems: NC, CNC and DNC machines. Data processing unit and machine control units. Tooling of NC machining and errors involved. Introduction to FMS and Computer Integrated Manufacturing systems, and Computer Aided Process Planning, Introduction to AGV.

Group Technology: Introduction to GT, GT cell and flow lines, different part coding systems part print analysis, optiz's and multi-class coding, Implementation of GT

Part Programming: Manual and Computer assisted, Introduction to APT Part Programming, Automatic Part Program Generation, Economics of NC Manufacturing.

Basic of Industrial Robotics: Basic Robot Motions, Introduction to Robot Programming, Control and Interlocks, Robot Sensors. Specific application in Welding, Spraying, Assembly, Processing Operation and Inspection.

PI 402A PRODUCTION PROCESSES III (PI)

Credit 4½, 4L, 1T 3 hours, 100 Marks

Metal Working: Two and three dimensional strains, principal stress and strains, strain deviators and its invariants. Strain rates, generalized Hooke's laws, Tresca and Von-mises yield criteria. Plastic stress-strain equations. Theories of plastic flow, slip line field theory, properties of slip lines, Hencky's slip line equations, Geiringer's Velocity equation, Velocity diagrams or hodographs,

Lower and upper bound techniques of load estimation, Elementary analysis of wire drawing process, drawing load, reduction limit, element of tube drawing; Forging of thin strips, forging of circular discs; rolling process, determination of roll separating forces and torques roll chamber, roll-passes; Elementary analysis of extrusion, forward and backward extrusion analysis, Extrusion force, Defects in Metal Working.

PI 403A PRODUCTION & OPERATIONS MANAGEMENT II (PI)

Credit 2½, 2L, 1T 3 hours, 50 Marks

Materials Management, Purchase Management, Inventory management, ABC and VED analysis, Material Requirement Planning (MRP), JIT, Kanban.

Project Management: Project Planning and Control, Use of CPM and PERT. Resource allocation and resource levelling, Optimum cost schedule.

Production Control: Routing, Dispatching, follow up and exepediting. Application of OR tools to PPC.

Introduction of Supply Chain Management, Business Process Reengineering, Group Technology & Management Information System.

PI 404A TOOL DESIGN I (PI)

Credit 2½, 3L, 1T 3 hours, 50 Marks

Design of Metal Cutting Tools: Design of single point cutting tools, Design for rigidity and geometry, design of chip breakers. Throw away tip cutting tools.

Tool and Die Materials: Characteristics of tool materials, High carbon steels, High speed steels, Cast cobalt base alloy steels. Cemented carbides and oxides CBN-UCON and Diamond. Selection of Material for Tool & Die.

Production of Cutting Tools: Blank preparation for cutting tools; Manufacturing processes for single point tipped tools, twist drills and plain milling cutters.

Form Tools and Tooling for Automatics: Flat circular and dovetail form tools, rake correction in form tools. Cam Profile Development for Automats.

Jigs and Fixtures: Principles of locating, various locating devices; Principles of clamping. Importance of clamping devices, clamping forces; Indexing devices. Jig bushes, Basic considerations in Jig-fixture design, some examples of design of drilling jigs and milling fixtures. Design of inspection fixtures for checking parallelism, perpendicularity flatness and roundness, Economics of Jigs and Fixtures.

PI 405 A PRODUCTIVITY ENGINEERING (PI)

Credit 2½, 2L, 1T 3 Hours, 50 Marks

Value Engineering:

Definitions of the Basic Terms; Scope and Philosophy of Value Analysis and Value Engineering; Determination of Functions and Functional Evaluation; Tools of Value Improvement; To Make or Buy, Elements of Cost and Cost Classification; Value Analysis Job Plan; Applications of Value Engineering*, Value Management:*

Productivity:

Introduction; Basic Concepts; Basic Definitions, Types and Scope of Productivity, Benefits of Higher Productivity at Various Levels, Diversity of Productivity Concept, Factors Affecting Productivity, Causes of Lower Productivity, The Total Productivity Model.

Productivity Measurement:

Basic Concepts; Need, Measurement Approaches, Productivity Measurement Models, Multi-factor Productivity Models, Introduction to Productivity Measurement at Industrial Levels.

Productivity Evaluation:

Basic Concepts; Expression for Total Productivity Change, Productivity Evaluation Tree.

Productivity Planning:

Basic Concepts; Importance of Productivity Planning, Long-term And Short-term Productivity Planning Models.

Productivity Improvement:

Basic Concepts; Sumanth's Five-pronged Productivity Improvement Models Technology-based, Material-based, Employee-based, Task-based and Product-based Techniques. Organisational Strategies for Productivity Improvement.

SEMESTER VIII

PI 451A (a) MARKETING AND FINANCIAL MANAGEMENT (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Nature and Function of Marketing: Importance, evaluation and functions of marketing, marketing organization, marketing mix. Formulation of marketing strategies.

Marketing Research : Meaning and scope, components of marketing research.

Consumer Behaviour: Consumer buying process, determinants of consumer behaviour.

Personal Selling and sales promotion; Advertising: Meaning and role of advertising, Management of advertising media planning and selection.

Distribution Channels: Classification of choice factors of intermediaries, distribution channel, policies and strategies.

Objectives of Financial Management: Organizational structure, Financial analysis and control : Ratio analysis, fund flow analysis.

Working capital management: Working capital needs and determinants, financing the current assets and working capital policy.

Cost of capital: Cost of debt, preference shares, equity retained earnings.

Capital Budgeting: Investment decisions and criteria for investment, net cash flows, net present value, pay back periods, rate of return, profitability index, return on investment (ROI), internal rate of return.

PI 452A (b) MODERN MACHINING METHODS (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Introduction: Classification of Modern Machining Processes, considerations in process selection.

Mechanical Processes: Ultrasonic machining, elements of USM, acoustic head and its design, tool feed mechanism, abrasive feed mechanism, generation, cutting tool system design, Mechanics of cutting, effect of parameters on material removal rate and surface finish, economic considerations, applications and limitations, recent

developments; Abrasive Jet machining, variables affecting material removal rate, applications, advantages and limitations; Water Jet Machining, Jet cutting equipment, process details and practical applications.

Electro-Chemical and Chemical Processes: Electro-Chemical Machining: Elements of the process, Electrolytes and their properties. Chemistry of the process, metal removal rate; thermal aspect; temperature profile and pressure flow rate relationship of electrolyte; tool design; accuracy and surface finish; advantages, applications and limitations of the process, electro-chemical grinding, deburring and honing.

Chemical Machining: Elements of process, Resists and Etchants, Advantages and applications.

Thermal Processes: Electric Discharge Machining: Mechanism of metal removal, EDM Equipment: Generators and feed control devices, Dielectric fluids, selection of electrode material, accuracy and surface finish, applications and future trends.

Plasma Arc Machining: Mechanism of Metal Removal, PAM parameters. Types of torches, accuracy and surface finish, economics and applications of Plasma jets, plasma arc spraying.

Electron Beam Machining: Generation and control of electron beam, Theory of Electron Beam Machining, Process capabilities and limitations.

Laser Beam Machining: Principles of Working, thermal aspects, material removal, cutting speed and accuracy, Advantages and Limittions.

PI 453A (c) WELDING ENGINEERING (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Welding and allied processes: Detailed study of GMA welding, GTA welding, submerged arc welding, Electron beam welding, Laser beam welding, Under water welding: Brazing and Soldering, Methods and Application; Thermal Spraying; Flame, arc plasma and detonation methods, Metal surfacing, weldability: Concept of weldability, Brief study of the problems and practices in welding low carbon stainless steel, cast iron, aluminium and copper alloys.

Welding Consumables: Coated electrodes; Type of electrode coatings. Classification and coding of coated electrodes as per BIS,

welding wire flux cored wires, electrodes, fluxes for submerged arc welding, shielding gases, Complete testing of Manual Metal Arc Welding as per IS: 814-1991.

Electric Arc and Power Sources: Structure and Physical characteristics of an electric arc efficiency. Arc initiation and maintenance, Energy balance characteristic of arc welding power sources, constant current and constant potential power sources. Duty cycle. AC and DC power sources and their selection, Arc control devices.

Metal Transfer and Metallurgical Aspects: Forces affecting metal transfer, modes of metal transfer, factors affecting metal transfer; power sources, polarity, schielding environment and welding position. Microstructural changes in the fusion and heat affected zones, dilution, gas metal reactions defects due to metallurgical factors, Elementary treatment of moving heat source and thermal stresses. Thermal distortion and its control.

PI 454A (d) FOUNDARY ENGINEERING (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Moulding and Casting Processes: Process characteristics of major moulding and casting methods, special moulding and casting processes; flaskless moulding, vacuum moulding, ceramic moulding, unicast and replicast process, counter gravity , low pressure casting, squeeze casting, semisolid casting and forging.

Foundry Equipment and Mechanization: Moulding and core making machines; sand reclamation; Melting furnaces, electric arc furnace, induction furnaces, crucible furnace, Design features of Cupola, water cooled and hot blast cupolas, performance characteristics of a cupola, control tests and analysis; vacuum melting, Automation in foundries, Layout of foundries, Ingredients of moulding materials; bonding mechanism, properties of moulding and core materials and their testing.

Solidification: Of pure metals and alloys, microstructural features, inoculation skin effect, directional solidification, Chorinov's rule, design of risers. External and internal chills, sleeves and paddings, use of thermic materials, Metal fluidity; Design of gating system, Gases in metals, degassing methods.

Thermal Stresses: Thermal stresses in castings and relieving of residual stresses.

Fettling and Inspection: Fettling of castings, inspection of casting, Analysis of casting salvage and rectification casting field, Elements of casting design.

Foundry Practices of Metals and Alloys: Foundry practices of grey cast iron, malleable iron, steel, aluminium alloys and copper base alloys.

PI 455A (e) COMPUTER AIDED DESIGN (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Introduction: Introduction to Computer Graphics Terminology; Basic 2D & 3D primitives: lines, circles, arcs, polygons, Box, Cylinder, Torus, Wedge. Two and three dimensional transformations and projections. Introduction to Auto CAD, Hidden line removals, Design, dimensioning, fits and tolerances. Optimum design of pin joints and welds, design for rigidity, computer aided stability analysis, optimum design of belts, clutches and brakes. Computer aided design of roating shafts for strength and rigidity. Introduction to Parametric Modelling, Concept of Design by Feature & Concept of Design for manufacturability.

PI 456A (f) ROBOTICS & SOFT COMPUTING (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Robotics: Introduction to Robotics, Brief History and Relevance in Modern Manufacturing Environment. Economic Analysis for Robot Installation in a potential manufacturing environment.

Robot Anatomy and its Peripherals. Physical configuration. End effectors, Sensors & other accessories. Work Volume. Control Systems and Configuration of a basic robot controller with feedback. Robot Drive Systems.

Robot Programming: General methods; capabilities and limitations. Robot Languages and their evolution. Introduction to commercially available programming languages for Robots. Robot Applications to common industrial operations such as machine loading, welding, assembly, inspection etc.

Advancements in Robotic Design: Machine Vision & Artificial Intelligence involvement in the design of robots for the future. Concept of Humanoid Robots. Social Issues and Future of Robotics.

Introduction to Soft Computing Techniques and their Evolution:

Fuzzy Logic and management of uncertainty. Concept of Membership Function. Introduction to common techniques of problem solving using Fuzzy Reasoning.

Neural Networks: Concepts of Learning and Introduction to Feedforwarded & Feedback Neural Networks. Introduction to Engineering Applications of ANN.

Genetic Algorithms: Introduction and conceptual framework of genetic evolution in computing. Introduction to common GA algorithms and their applications.

PI 457A (g) COMPUTER AIDED PROCESS PLANNING (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Introduction to Manufacturing: Manufacturing industries, systems, processes & planning.

Basic Information for Process Planning: Drawing & specification of a work piece, Drawing of the blank piece, volume of production, production equipments etc.

Manufacturing Process Planning: Definition of Process Planning & its importance, various approaches, Mission of Process Planning.

Computer Integrated Manufacturing, CAD, CAM, Manufacturing database & its application in process planning. Knowledge based expert systems.

Group technology in process planning- Historical background, classification & coding, application of GT.

Implementation of CAPP Systems: Format of decision rules, forward and backward planning, format of input & output application of AI in process planning.

Programming Languages used in development of CAPP. Role of Expert Systems.

Feature based design: IGES / PDES / STEP & data sharing, feature definition, classification, recognition etc.

Process Planning Knowledge: Process knowledge, Intermediate surface identification, process sequencing, workpiece knowledge, Machine knowledge, Machining Parameter knowledge, production rules, operation selection for different features etc.

Study of various CAPP systems.

PI 458A (h) SIMULATION (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

System Models: Concept of a system, system environment, stochastic activities, continuous & discrete systems, types of models-static physical models, dynamic physical models, static mathematical models, dynamic mathematical models, system studies.

System simulation: Tchnique of simulation, Monte Carlo Method, Comparison of simulation & analytical methods, Experimental nature of simulation, Numerical computation technique for continuous models & discrete models.

Probability concept in simulation: Stochastic variables, discrete & continuous probability functions, Measures of probability functions, Continuous uniformally distributed random numbers, computer generation of random numbers, A uniform random number generator, generating discrete distributions, non uniform continuously distributed random numbers.

Continuous system simulation: Continuous system models, Analog Methods, digital analog simulators, continuous system simulation languages, Hybrid simulation, feedback systems, interactive systems, Real time simulation, Simulation of a water reservoir system.

Arrival patterns & service times: Congestion in system, Arrival Patterns, Poisson arrival pattern, The exponential distribution, service time, the normal distribution, queuing disciplines, measures of queue.

Discrete System Simulation: Discrete events, representation of time, generation of arrival patterns, gathering statistics, counters & summary statistics, measuring utilization & occupancy, discrete simulation language, simulation of a telephone system.

PI 459A (i) FINITE ELEMENT METHOD (ELECTIVE I)

Credit 4, 3L, 2T 3 hours, 75 Marks

Mathematical preliminaries. Fundamentals of weighted residual and variational methods, variational formulation of problems, triangulation and mesh generation techniques, Ritz and Galerkin finite element techniques for solution of boundary value problems of ordinary and partial differential equation; triangular, rectangular and quadrilateral, finite elements, interpolation and continuity functions, isopara-metric elements and matrices, Applications to Engineering Mechanics, Stress Analysis fluid flow and head transfer problems, computer programming problems with examples.

PI 460A (a) OPERATIONS RESEARCH II (ELECTIVE II)

Credit 4, 3L, 2T 3 hours, 75 Marks

Extension of Linear Programming: Revised Simplex method, Theory of Duality. Unbounded solutions, Unrestricted variables, Multiple Optimal Solutions and Degeneracy, Sensitivity Analysis, Dual Simplex Method, Parametric Programming. Goal Programming.

Integer Programming: Cutting Plane Algorithms, Branch and Bound Method, Zero-One applications to Engineering Problems.

Dynamic Programming: Concept, the recursive equation approach, Application of Dynamic Programming to Engineering Problems; Stochastic Dynamic Programming Models.

Simulation: The Philosophy, Pseudo-Random Number generation and testing, Generating Random Deviates; Design development and implementation of Simulation Models.

Introduction to Non-Linear Programming: Optimization of non-linear function of single variable, of several unconstrained variables: Methods of Steepest ascent / descent. Optimization with non-linear constraints.

Introduction to Quadratic Programming and Geometric Programming with their engineering applications.

PI 461A (b) SYSTEM ENGINEERING (ELECTIVE II)

Credit 4, 3L, 2T 3 hours, 75 Marks

Introduction: Concept and types of systems, system models, physical and socio-economic systems, flow graph, representation of system, mathematical model building, management information system, communication and information system.

Procedure for Engineering System: Function, Defining system, objective, formation of objective criteria. Development of system, preliminary and detailed design.

System Dynamics: System response characteristics, stability and basic concepts of feed back systems, post-optimality analysis, large scale system simulation, industrial dynamics, application of systems, analysis, concepts, business, managerial systems, case study.

Man Machine Systems: Their classification & characteristics. Introduction to Human Transfer function.

PI 462A (c) PRODUCTIVITY MANAGEMENT (ELECTIVE II)

Credit 4, 3L, 2T 3 Hours, 75 Marks

Productivity:

Introduction and Basic Concepts; Diversity of Productivity Concept; Relationship of Productivity with Efficiency & Effectiveness; Measures of Productivity; Benefits of Higher Productivity at Various Levels; Factors Affecting Productivity and Their Importance; Productivity Benefit Model.

Productivity Engineering and Management

The MEPI Cycle and its Importance; Relationship between Productivity Engineering and Industrial Engineering; Productivity Management.

Productivity Improvement Concept

Causes of Productivity Decline; Principles of Productivity Improvement; Some Existing Approaches to Productivity Improvement (Goodwin's Model, Sutermeister's Model, Hershaauer & Run's Model, Crandall's & Wooton's Mocel, Stewart's Model, Aggarwal's Approach) Analytical Productivity Improvement Models; Setting-up Formal Productivity Improvement Program: Organizational Structure, Human Aspects, Implementation Schedule, Evaluation Criteria & Common Problems.

Total Productivity Model (TPM)

Its Basic Concept and Salient Features; Various Input and Output Factors; Operational Total Productivity Model; Mathematical Modeling of Profit vs Total Productivity; Productivity Measurement Strategy using TPM; Relationship between Total & Partial Productivities; Various Productivity Indicators.

Productivity Measurement

Need, Measurement Approaches; Productivity Measurement Aspects at Organizational, Industrial, National and International Levels; Kandrick-Creamer Model, Craig-Harris Model, Hine's Model, APC Model; Multi-factor Productivity Models.

ProductivityEvaluation

Its basic concepts & importance; Expression for Total Productivity Change between two Successive Time Periods; Productivity Evaluation Tree.

Productivity Planning

Its basic concepts & importance; Basic Short-term & Long term Productivity Planning Models.

Productivity Improvement Techniques

Technology-based, Material-based, Task-based, Employee-based and Produced-based; Organizational Strategies for Productivity Improvement; Organizational Charts (Employee-based and Produced-based); Productivity Improvement in Manufacturing and Service Organizations.

PI 463A (d) PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS (ELECTIVE II)

Credit 4, 3L, 2T 3 hours, 75 Marks

Personnel Function : Its Evolution, Objectives, Principles, Philosophies. Duties and Responsibilities of Personnel Manager, Position of Personnel Department in the Organisation. The changing concept of Personnel Management in India.

Manpower Planning: Its use and benefits, problems and limitations, Manpower Inventory, Manpower forecasting.

Recruitment: Selection Process; psychological testing; Interviewing Techniques, Transfer, Promotion and its policies, Induction placement and Exit interview.

Compensation: Basic Compensation; Significant factors affecting compensation policy.

Job Evaluation: Principle and methods, Expectancy theory and compensation : Supplementary compensation and fringe benefits.

Wages and Salary Administration.

Training and Development: Objective, Policy Planning and Organising. The Training Department, Training Manager and his duties, On job and off job training techniques, Career planning, Performance Appraisal its objective and methods.

Industrial Relations: Problems of Labour-Management relations, Causes for poor industrial relations, conditions of good industrial relations.

Labour Related Acts : Trade Union Act; objectives and advantages of trade unions, collective bargaining.

Industrial Dispute Act; Disciplinary action and domestic enquiries,

Machinery for settlement of disputes; Grievance Procedure and its handling, counselling, Lay off Lockouts, Strike and Labour Retrenchment.

Salient features of Factories Act, ESI Act, and other Social Security Acts.

PI 464A (e) MANAGEMENT INFORMATION SYSTEM (ELECTIVE II)

Credit 4, 3L, 2T 3 hours, 75 Marks

Introduction to Management Information Systems: An overview of MIS, Information Resource Management, Information Technology Fundamentals key issues in MIS.

Survey of Information Systems Technology: Hardware, Software and Communication Technology of Information Systems, Storage and Retrieval of Data, Transaction Processing, Office Automation, Information Processing Control Functions and other Strategic uses of I.T.

Database Management Systems: Data Management, File Management, Data Access and Organization Method, Database Management, Database Management for Large Systems, External Databases and Information Services. Transaction Processing and Management Reporting Systems.

Decision Support Systems: DSS goals and applications, components of DSS, DSS development, DSS examples, Group Decision Support systems, Executive Information Systems.

MIS in the Functional Areas of Business: Financial Information Systems, Marketing MIS, Manufacturing MIS, MIS in other Business Areas like in R&D, HRD and SCM

PI 465A MACHINE TOOL DESIGN (PI)

Credit 4, 3L, 2T 3 hours, 75 Marks

Classification of machine tools, cutting force and power requirements in turning, drilling, milling, grinding and shaping operations. Determination of principal specifications; speed, feed and power ratings. Layouts for spindle speeds, optimum ray diagram; Design of head stock and feed gear boxes, Mechanical drives for rotary, rectilinear and intermittent motions, quick return mechanism.

Mechanical devices for stepless regulation of machine tools, power screws for machine tools, ball recirculating power screws, compensation of backlash.

Strength and rigidity of machine tool structures, static compliance of machine tools; torsional rigidity, beds, columns and slide ways for machine tools.

Hydraulic control system in machine tools. Elements of hydraulic system, basic design parameters. Study of Hydraulic Control Mechanism in Shaper.

Introduction to Dynamics of Machine Tools: Vibration analysis as applied to machine tools, dynamics of cutting processes, chatter, sources of torsional vibration, Vibration dampers, practical design considerations.

PI 466 A : INTELLECTUAL PROPERTY RIGHTS

Credit 4, 3L, 2T 3 Hrs, 75 Marks

Introduction : Meaning and scope of Intellectual Property. Introduction to Intellectual Property Rights and its significance in Engineering, Place of intellectual property in other forms and kinds of property and respective characateristics, need for development and protection of intellectual property Commercial Aspects of IPR. Various forms of Intellectual Property Rights : Copyrights, Trademarks, Patents, Geographical Indications and Traditional Knowledge, Industrial Designs, Semiconductor and Integrated Circuits, Trade Secrets. Nature, term and conditionality in each such right, laws dealing with the rights, expiration of the right.

International treaties pertaining to IPR protection, World Intellectual Property Organization (WIPO) and agreement in Trade Related Aspects of Intellectual Property Rights (TRIPS)

Indian Patent Act, 1970 : History of patenting system in India, Introduction to Indian Patent Act and Rules, Types of Patent Applications. Various Sections in an application.

Introduction to The Copyright Act, 1957; The Trade Marks Act, 1999 ; The Design Act, 2000; The Geographical Indications of Goods (Registration and Protection) Act, 1999; The Semiconductor Integrated Circuits Layout-Design Act, 2000.

Introduction to patent search; landscape analysis.

IPR Management : IP protfolio management- Importance and significance of IP protfolio management in an organization, IP Audit.

PI 467A TOOL DESIGN II (PI)

Credit 4, 3L, 1T 3 hours, 50 Marks

Forging Tool and Die Design: Basic die design concepts and procedure, Design for forging and die forging, Parting line selection, Pre forming operations, design of Pre forms, design fundamentals of fullers and blockers, design of die blocks. Rules of upsetting, Design of simple upsetting Dies, Selection and capacity calculation of hammers and presses.

Press Tool Design: Major components of a mechanical press. Selection of presses, cutting action in a die, characteristics of a sheared edge. The effect of clearance on cutting, blanking and piercing, Punch press energy, centre of pressure, cutting force and press energy requirement, design of die blocks and punches. Design concepts of strippers. Knock out, stops, pilots, Scrap strip layout. Concept of progressive dies.

Design Concepts of Bending Dies: Blank length, spring back, bending radii, width of die opening and bending pressure. Design of bending dies for simple components.

Drawing die design: Calculation of blank diameter, number of draws, pressure, allowance and punch radius, combination dies. Development of draw die for mass manufacturing of common objects.

PI 468 A PRODUCTION PROCESSES IV (PI)

Credit 4, 2L, 1T 3 hours, 50 Marks

Modern Machining: Classification of modern machine methods, Abrasive jet machining, Water jet machining and water abrasive jet machining; Chemical and electrochemical machining, Electric discharge machining, Plasma arc machining; Electron beam machining; Laser beam machining and Ultrasonic machining.

Non Destructive Testing : Meaning and scope of NDT, Dye penetration testing, Magnetic Particle testing; Principle, currents, fields, selection of particles and testing procedure.

Ultrasonic Testing : Principle equipments, testing, techniques, calibration and interpretation of symbols, Introduction to Eddy current and Radiographic testing.

PI 469A: SUPPLY CHAIN MANAGEMENT

Credit 4, 2L, 1T 3 Hrs, 50 Marks

Introduction to supply chain management: What is supply chain management (SCM)? Global optimization, Managing uncertainty, key issues in SCM.

Inventory management and risk pooling: Introduction, A single warehouse inventory model, Centralized versus Decentralized systems, Managing inventory in supply chain, Practical issues, Forecasting.

The value of information: Introduction, The bullwhip effect, Effective forecasts, Information for the coordination of systems, Locating desired products, Lead-time reduction, Information and supply chain trade-offs.

Supply chain integration: Introduction, Push, Pull, Push-Pull systems, Demand driven strategies, The impact of Internet on supply chain strategies, Distribution strategies, Centralized versus Decentralized Control, Central versus Local facilities.

Strategic alliances: Introduction, Framework for Strategic alliances, Third party logistics, Retailer-supplier partnerships, Distribution integration.

Procurement and outsourcing strategies: Introduction, Outsourcing benefits and risks, Framework for make or buy decisions, E-procurement.

Customer value and SCM: Introduction, Dimensions of customer value

Information technology for SCM: Introduction, Goals of supply chain information technology, Information technology infrastructure, SCM systems components, Integrating supply chain information technology.

Decision support systems for SCM: Introduction, SCM Modeling, Structure for Decision support systems, Supply chain Decision support systems, selecting a DSS supply chain.

Performance Measurement of SCM: Introduction, SCM performance metrics, Framework for performance measurement.