भारतीय प्रौद्योगिकी संस्थान रूड़की
रूड़की – 247 667 (भारत)
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE - 247 667 (INDIA)

सीनेट की अठत्तरवीं बैठक हेतु कार्य सूची
AGENDA FOR THE
78th MEETING OF THE SENATE

बैठक सं0	: अठत्तरवीं
MEETING NO.	**: 78th**
स्थान	: सीनेट हॉल, भा0प्रौ0सं0 रूड़की
VENUE	**: Senate Hall, IIT Roorkee**
दिनांक	: 10 अप्रैल 2019
DATE	**: 10th April 2019**
समय	: 3.30 बजे अपरान्ह
TIME	**: 3.30 P.M.**

भारतीय प्रौद्योगिकी संस्थान रूड़की

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

रूड़की 247 667

ROORKEE – 247 667

कार्यसूची/A G E N D A

मुद्दा सं0/ **Item No.**	विवरण/**Particulars**	पृष्ठ/ **Page(s)**
78.1	सीनेट की दिनांक 02.01.2019 को आयोजित हुई 76वी बैठक के कार्यवृत्त की पुष्टि करना। To confirm the minutes of the 76th meeting of the Senate held on 02.01.2019.	1
78.2	सीनेट की दिनांक 02.01.2019 को आयोजित हुई 76वी बैठक में लिए गए निर्णयों के कियान्वयन हेतु की गई कार्रवाई को रिपोर्ट करना। To report on the actions taken to implement the decisions of the Senate taken in its 76th meeting held on 02.01.2019.	2-8
78.3	निम्नलिखित नये पाठ्यक्रमों को समाविष्ट करने के प्रस्ताव पर विचार करना। (अ) यूजी रिसर्च कोर्स (यूजीआरसी001) – 3 केडिटस, विभाग स्पेसिफिक (आ) अंतर्विषयक यूजीआरसी (यूजीआरसी001) – 3 केडिटस, सभी विभागों के अंतर्विषयक परियोजानाओं के लिए उपयुक्त। To consider the proposal to introduce following new courses: (i) UG Research Course (UGRC001) - 3 Credits, Department specific (ii) Interdisciplinary UGRC (IUGRC001) - 3 Credits, applicable for all Departments interdisciplinary projects.	9-10
78.4	यूजी और पीजी प्रोजक्ट/डिजरटेशन मूल्यांकन के लिए संशोधित दिशानिर्देशों पर विचार करना। To consider the revised guidelines for evaluation of UG and PG project/dissertation.	11-16
78.5	सत्र 2019–20 के लिए शैक्षणिक कैलेंडर पर विचार करना। To consider the Academic Calendar for the session 2019-20.	17-22

78.6	ग्रेडिंग रूल्स रिव्यू कमेटी की संशोधित रिपोर्ट पर विचार करना। To consider the Revised Report of Grading Rules Review Committee.	23-25
78.7	धातुकर्म एवं पदार्थ इंजीनियरिगं विभाग और वास्तुकला एवं योजना विभाग द्वारा पीएचडी में प्रवेश के लिए प्रस्तावित संशोधित न्यूनतम पात्रता मानदंड पर विचार करना। To consider the modified minimum eligibility criteria for admission in Ph.D. programme as proposed by Department of Metallurgical and Materials Engineering and Department of Architecture and Planning.	26-27
78.8	थीसिस जमा करने के लिए समय विस्तार के संबंध में दो छात्रों के अनुरोध पर विचार करना। To consider the request of two students regarding extension in time for the submission of thesis.	28
78.9	पीएचडी प्रोगाम की कोर्स क्रेडिट आवश्यकता को पूरा करने के लिए जिन रिसर्च स्कॉलर्स ने ऑटम/स्प्रिंग सेमेस्टर 2018–19 में यूजी स्तर का कोर्स लिया है उनको वन टाईम अपवाद (एक्सपशन) देने के लिए भूविज्ञान विभाग की डीएपीसी और डीआरसी की सिफारिशों पर विचार करना। To consider the recommendations of DAPC and DRC, Deptt. of Earth Sciences, to give one time exception to Research Scholars who took UG level courses in Autumn/Spring semester 2018-19 to complete course credit requirement for Ph.D. programme.	29-31
78.10	2019–2020 के लिए जेम्स थॉमसन छात्रवृत्ति (जेटीएस) के लिए कट–ऑफ रैंक पर विचार करना। To consider the cut-off rank for James Thomason Scholarship (JTS) for 2019-2020.	32
78.11	प्रो0 मनीष श्रीखंडे समिति द्वारा प्रस्तावित पीचडी नियमों और विनियमों भाग 2: पीएचडी प्रकिया के शेष भाग पर विचार करना। To consider the remaining clauses of Part-II: Ph.D. Procedures as proposed by Prof. Manish Shrikhande Committee on Ph.D. Rules & Regulations.	33
78.12	उन छात्रों को अनंतिम पी0एच0डी0 उपाधि प्रदान करने की पुष्टि किया जाना, जिन्होंने विभिन्न पाठ्यक्रमों में 8 अक्तूबर 2018 से अब तक उपाधि प्राप्त किए जाने की अर्हता प्राप्त की है। To ratify the award of provisional Ph.D. Degrees certificate to the students who have completed the requirements for the award of Ph.D. Degree in various disciplines w.e.f. 02.01.2019 to date.	34-40
अन्य मद अध्यक्ष की अनुमति से/Under any item with the permission of the Chair.		

Item No. 78.1: To confirm the minutes of the 76th meeting of the Senate held on 02.01.2019.

The minutes of the 76th meeting of the Senate held on 02.01.2019 were circulated to the members vide e-mail dated 25.01.2019. No comments have been received.

The Senate may consider confirming the said minutes.

Item No.78.2: To report on the actions taken to implement the decisions of the Senate taken in its 76th meeting held on 02.01.2019.

The minutes of the 76th meeting of the Senate held on 02.01.2019 were circulated to the members vide e-mail dated 25.01.2019. The status of actions taken is as under:

Item No.	Reference to the Senate minutes	Abstract of the Minutes	Status of action taken
76.3	Proposal regarding addition of Exceptional 3rd to 5th year UG Students as Teaching Assistants (UGTA) for the courses of first year.	The Senate approved the proposal of having UGTAs with the following provisions: 3rd – 5th year UG students are eligible for becoming UGTAs. A department using UGTAs should have a process to select them from among the interested students. On similar lines, a department using PG (this includes Ph.D. students) students to conduct UG tutorials should have a process to select them from among interested PG students. A UGTA is allowed to conduct tutorial classes of 1st year only. The concerned teacher should keep track of the performance of TAs and UGTAs involved in conducting tutorial classes. At the end of the semester, students' feedback of such TAs and UGTAs should also be taken and shared with them. The responsibility for good and effective conduct of the course will continue to be that of the concerned teacher.	Notified.
76.4	Proposal to waive off attendance requirement for the students who received F grade and are repeating the course.	The Senate approved waiving off of the attendanc requirement for lecture classes only.	Notified.

76.5	Proposal to amend the Regulation 31(a) of Academic Programmes Regulations for UG regarding withdrawal from course.	The Senate approved the proposal and extended the same to M.Tech. & Ph.D. students also. Further, 'withdrawal' grades will not be recorded on the transcript.	Notified.
76.6	Proposal of allowing up to 2 courses (maximum 8 credits) PECs from sister Departments in UG curriculum.	The Senate approved the proposal if both, DAPC of the department to which the student belongs and Coordinator of the course to be taken consent.	Notified.
76.7	Report of Unfair Means Rules Committee.	The Senate approved the proposal.	Notified.
76.8	Proposal to amend the Regulation 18(2) of Academic Programmes Regulations for UG regarding restrictions on subject registration in current semester with backlog papers.	The Senate approved the proposal.	Notified.
76.9	Proposal of Department of Electrical Engineering to discontinue the core course EEN-310 (General Viva).	The Senate approved the proposal with effect from the current semester.	Notified.
76.10	Proposal of Department of Management Studies to allow all graduates for MBA Admission at IIT Roorkee.	The Senate approved the following eligibility criteria for admission in MBA programme: Graduates, or a professional qualification equivalent to that of a University degree recognized by UGC, in any discipline with minimum 60% marks (55% marks for SC/ST/PD).	Notified.

76.11	Structure & Syllabi of all courses for III, IV and V year of Integrated M.Sc. (Chemistry) proposed by the Department of Chemistry.	Senate approved the proposal.	Notified.
76.12	Proposal of Department of Electronics and Communication Engineering to change the eligibility criteria for admission to M.Tech. (Microelectronics and VLSI), to B.Tech./B.E.(Electronics and Communication Engg. or equivalent, M.Sc. (Physics)/ (Electronics) or equivalent with a valid GATE score in EC/ Physics streams.	The Senate approved the proposal.	Notified.
76.13	Recommendation of DFC of Department of Chemistry to close the M.Tech. (Advanced Method of Chemical Analysis) programme due to poor inflow of the students and placement record.	The Senate approved the proposal.	Notified.
76.14	Proposal for admission of IIT graduates (with CGPA 8 and above) over and above the sanctioned intake for M.Tech. programme from the year 2019 onwards.	The Senate approved the proposal.	Notified.
76.15	Modification in Ph.D. Forms in line with the decisions taken in recent Senate meetings.	The Senate authorized IRC/IAPC to approve the forms as per the decisions of the Senate. Approval, so accorded, be reported to the Senate.	Decision has been communicated to Dean (Academic Affairs)

76.16	Part-II: Ph.D. Procedures as proposed by Prof. Manish Shrikhande Committee on Ph.D. Rules & Regulations.	The item was deferred.	Deliberations continuing.
76.18	Models for Collaborative Doctoral Programmes with Foreign Universities.	The Senate approved the proposal.	Decision communicated to Associate Dean (International Relations)
76.19	Proposal of renaming the Alternate Hydro Energy Centre as Hydro and Renewable Energy Department.	The Senate accepted the proposal and recommended it to the Board for approval.	The proposal has been placed before the Board.
76.20	Case of missing ETE answer scripts of two students of a course in Autumn Semester (2018-19).	The Senate took a very serious note of the matter and desired that a strong message be sent to prevent recurrence of any such lapse in future. Further, the Senate approved the recommendations of the IAPC.	Notified.
76.21	Requests/appeals from following students regarding continuation of programme in spite of not fulfilling the minimum earned credit requirement. **1.** Mr. Bhethala Sai Sujith (Enr No. 17119011), B.Tech. (PI) **2.** Mr. Bhukya Bhargav (Enr No. 17115027), B.Tech. (EE)	The Senate did not accept the appeals.	Informed.

<table>
<tr><td>76.22</td><td>Mercy petition of Mr. Dipanshu Chaudhry (Enr No. 10113034), B.Tech. Civil Engg. for re-enrolment and registration for balance credits to complete the degree requirement.</td><td>The Senate accepted the appeal of Mr. Dipanshu Chaudhry.</td><td>Informed.</td></tr>
<tr><td>76.23</td><td>Mercy appeal of students regarding continuation of studies in spite of not meeting the criteria of minimum earned credits.</td><td>The Senate did not accept the appeals.</td><td>Informed.</td></tr>
<tr><td>76.24</td><td>Requests of 1st year M.Tech./M.Sc. students regarding continuation of programme in spite of not fulfilling minimum SGPA.</td><td>The Senate accepted the following appeals:
<table>
<tr><th>S. N.</th><th>Name</th><th>Enr No.</th><th>Programme</th></tr>
<tr><td>1.</td><td>Myat Sithu Lwin</td><td>18541014</td><td>M.Tech. (ME) (International Student)</td></tr>
<tr><td>2.</td><td>Chalachew Dagnew Yehuala</td><td>18538011</td><td>M.Tech. (ME) (International Student)</td></tr>
<tr><td>3.</td><td>Chan Aye Aung</td><td>18530019</td><td>M.Tech. (EE) (International Student)</td></tr>
<tr><td>4.</td><td>Mushar Kishan Lakhabhai</td><td>18530012</td><td>M.Tech. (EE) (Indian Student)</td></tr>
<tr><td>5.</td><td>Rahul Tripathi</td><td>18512016</td><td>M.Tech. (AH) (Indian Student)</td></tr>
<tr><td>6.</td><td>Anil Gautam</td><td>18519001</td><td>M.Tech. (CE) (Indian Student)</td></tr>
</table></td><td>Informed.</td></tr>
</table>

		7.	Farhad Khiabani	18519004	M.Tech. (CE) (International Student)	
		8.	Ismail Ahmed Aden	18548034	M.Tech. (WR) (International Student)	
		9.	Nitin Saini	18537014	M.Tech. (Hydrology)	
76.25	Seat matrix for PG (M.Tech./ M.Arch./ MURP) admission for the session 2019-20.	The Senate approved the seat matrix for Masters' programmes for the session 2019-20.				Decision has been communicated to Associate Dean of Academic Affairs (Admission)
76.26	Proposal for Excellence in Doctoral Research awards.	The Senate approved the proposal with the following changes: (1) Any student getting Ph.D. degree in the Convocation will be eligible to apply if recommended by his/her supervisor. (2) All the reports of the examiners, alongwith their names and affiliations, will be shared by the Academic Affairs Office with the screening as well as the final committee. (3) The overall recommendation will depend on the quality and quantum of publications, novelty of the work, contribution and understanding of the student, reports and standing of the examiners, potential for industrial applications etc.				Decision has been communicated to Chairman, SCSP.

76.27	Proposal for converting Bagchi Gold Medal into Bagchi MCM	The Senate approved the proposal.	Decision has been communicated to Chairman, SCSP.
76.28	Proposal for Gold Medal for the Annual Convocation 2018.	The Senate approved the proposal.	Decision has been communicated to Chairman, SCSP.
Item No. 76.17 was deferred. Items Nos. 76.29, 76.30 & 76.31 were only for reporting to the Senate.			

Item No. 78.3: To consider the proposal to introduce following new courses:

(i) UG Research Course (UGRC001) - 3 Credits, Department specific

(ii) Interdisciplinary UGRC (IUGRC001) - 3 Credits, applicable for all Departments interdisciplinary projects.

As per the proposal, a student working with a faculty member in his/her department can register for the course UGRC001 and in the case of IUGRC001 a student working with a faculty member in a different department can register for this course in the department of the faculty member.

A student can only register for this course when he/she has the recommendation of the faculty member and the project work has been completed producing substantial results. The interested students may register for these courses as and when the work is complete. The evaluation of the course is to be carried out by a committee constituted by the DAPC.

The IAPC in its 69th Meeting held on February 21, 2019 recommended the proposal. **(Appendix 'A')**

The above is submitted for the consideration and approval of the Senate.

To
Dean of Academic Affairs
IIT Roorkee

Proposal: To introduce new extra credit courses on UG Research Course(UGRC001) and Interdisciplinary UGRC(IUGRC001).

Structure:

UGRC: A 3-credit course in which a student working with a professor in his/her department can register for this course. A student can only register for this course when he/she has the recommendation of the professor and the project work has been completed producing favourable results.

IUGRC: A 3-credit course in which a student working with a professor in a different department can register for this course **in the department of the professor.** A student can only register for this course when he/she has the recommendation of the professor and the project work has been completed producing favourable results.

Hence these courses (IUGRC or UGRC) need not be registered at the beginning of a semester and should be added any time when the work is complete. HoD should constitute a committee, which will evaluate the work and assign grade for the same.

Justification: Sister IITs(IIT Bombay and IIT Madras) have recently introduced Credits for undergraduate research work carried out with a faculty at their home institute. We are proposing a similar structure but also taking into account the uniqueness of our IIT from sister IITs. The major aim is to foster a research culture amongst the UG students of IIT Roorkee. The trend is that most of the UG students don't get an incentive to carry out research during the semester due to the load of coursework and they leave the project midway. But, if they are earning credits for the same and are awarded grades for their quality research, they are more likely to cling on to the project and bring about favourable results.

Yours Sincerely,

Sarim Khan
General Secretary Academic Affairs(UG), IIT Roorkee
Student Affairs Council

Item No. 78.4: To consider the revised guidelines for evaluation of UG and PG project/dissertation.

To standardize the procedure for evaluation of UG and PG project/dissertation, guidelines have been proposed with necessary amendments in the present practice. The IAPC in its 69th Meeting held on February 21, 2019 considered the proposal and recommended it with minor modifications **(Appendix 'A')**.

The above is submitted for the consideration and approval of the Senate.

Guidelines for evaluation of Int MTech / MTech Dissertation

Credits: 30 **Stage-I :** 12 **Stage-II :** 18

Finalization of supervisor(s)* and broad area of dissertation: one semester prior to Stage-I evaluation

Finalization of title of dissertation: at the time of final evaluation/submission of thesis.

Submission of thesis: At least one week prior to the date of evaluation

Evaluation of Stage-I : 12 credits to be completed by the time of grade finalization of Autumn semester.

Evaluation of Stage-II :18 credits to be completed by the end of June.

Evaluation Board: Supervisor(s), all the faculty members of the concerned specialization, one of whom as appointed by the Chairperson DAPC will act as the chairperson of the evaluation board.

Marks Distribution

Supervisor(s)	: 35%	Evaluation board (excluding supervisor): 65%
Thesis	: 30%	
Presentation	: 30%	
Viva-voce	: 40%	

Thesis Submission: in prescribed format (digital and hard bound)

Grading method: Absolute

Minimum passing grade : D+

If the final grade is below D+, the thesis has to be re-submitted and re-evaluated after 4 months. There would not be any restriction on the grade after re-evaluation.

*Co-supervisor can be taken from outside the Department also.

B1

Guidelines for evaluation of Int MSc/MSc Dissertation/Project

Credits: 12**Stage-I** :03**Stage-II** :09

Finalization of supervisor(s)* and broad area of dissertation: one semester prior to stage-I evaluation

Finalization of title of dissertation: at the time of submission of thesis/report.

Evaluation of Stage-I :3 credits (25%) to be completed by the time of grade finalization of Autumn semester.

****Evaluation of Stage-II** :9 credits (75%) to be completed by the time of grade finalization of Spring semester.

Evaluation Board: Supervisor(s), all the faculty members of the concerned specialization, one of whom as appointed by the Chairperson DAPC will act as the chairperson of the evaluation board.

Marks Distribution (out of 100):

Supervisor(s)	: 35%	Evaluation board (excluding supervisor): 65%
Thesis	: 30%	
Presentation	: 30%	
Viva-voce	: 40%	

Report Submission: in prescribed format (digital and hard bound)

Grading method: Absolute

In case a student has been awarded failing grade, he/she shall have to repeat the course in the form of a new project working full-time on the project for a minimum duration of 4 months.

*Co-supervisor can be taken from outside the Department also.

**In the programs where the project/dissertation is of only one semester duration and is carried out only in one stage, 100% evaluation would be carried out in the final semester.

B2

Guidelines for evaluation of B Tech Project

Credits: 12 **Stage-I** :04**Stage-II** :08

Finalization of supervisor(s)* and broad area of project: Latest by the start of 7th semester.

Finalization of title of project: Latest by Mid-Term Evaluation in Spring Semester

Evaluation of Stage-I :4 credits to be completed by the time of grade finalization of Autumn semester.

Evaluation of Stage-II :8 credits to be completed by the time of grade finalization of Spring semester.

Evaluation Board: To be decided by the DAPC

Marks Distribution (out of 100):

Supervisor(s)	: 35%	Evaluation board (excluding supervisor): 65%
Thesis	: 30%	
Presentation	: 30%	
Viva-voce	: 40%	

Report Submission: in prescribed format (digital and hard bound)

Grading method: Absolute

In case a student has been awarded failing grade, he/she shall have to repeat the course in the form of a new project working full-time on the project for a minimum duration of 4 months.

*Co-supervisor can be taken from outside the Department also.

B3

SAMPLE COPY

GEOTECHNICAL INVESTIGATIONS OF VISHNUGAD-PIPALKOTI HYDEL PROJECT, GARHWAL, INDIA

16 + Bold & Single Space

NOTE: Font may be Arial or New Time Roman all through out

M Sc/M Tech/B Tech Project/Dissertation

12 + Bold

by

12 Italic

K. LAKSHMANAN

12 + Bold

Seal size 1.75" by 1.75" New Seal

INSTITUTE INSTRUMENTATION CENTRE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE – 247 667 (INDIA)
MAY, 2016

14 + Bold and Single Space

Seal size .75" by .75" New Seal

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE ROORKEE

16 + Bold & Single Space

CANDIDATE'S DECLARATION

14 + Bold underline

I hereby certify that the work which is being presented in the thesis entitled **"GEOTECHNICAL INVESTIGATIONS OF VISHNUGAD-PIPALKOTI HYDEL PROJECT, GARHWAL, INDIA"** in partial fulfilment of the requirement for the award of the Degree {name of the degree} submitted in the Department of Earth Sciences of the Indian Institute of Technology Roorkee, Roorkee is an authentic record of my/our {Names of all the students in the group} own work carried out under the supervision of Dr. R. Anbalagan, Professor, Department of Earth Sciences, Indian Institute of Technology Roorkee.

12 + Line Space 1.5 and Topic in inverted comma's +Bold

The matter presented in this report has not been submitted by me/us for the award of any other degree of this or any other institution.

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(K. LAKSHMANAN) 12 + Bold

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

12 + Line Space 1.5

12 + Unbold & both line Single Space

(R. Anbalagan)
Supervisor

Date: 12 + Bold

Item No. 78.5: **To consider the Academic Calendar for the session 2019-20.**

The Academic Calendar Committee in its meeting held on February 19, 2019 recommended the Academic Calendar for the session 2019-20 **(Appendix 'A').**

The above is submitted for the consideration and approval of the Senate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

ACADEMIC CALENDER FOR THE YEAR 2019-20

(Autumn Semester)

Appendix 'A'

Item No. Senate/78.5

S. No.	Details	Autumn Semester	
		Date	Day
1.	Reporting and Academic Registration of New PhD and Masters' students	12.07.2019	Friday
2.	Re-examination and Second examination (for Spring Semester 2018-19)	12.07.2019- 15.07.2019	Friday- Monday
3.	Academic Registration of existing students in the Departments/Centres	16.07.2019	Tuesday
4.	Commencement of Classes for existing students & new PG(including PhD) students	17.07.2019	Wednesday
5.	Reporting and Academic Registration of new UG (including IMT/IMS) studentsadmitted through JEE (advanced)	20.07.2019	Saturday
6.	Last date for sending the grades of Re-examination	22.07.2019	Monday
7.	Commencement of Classes fornew UG students admitted through JEE (advanced)	24.07.2019	Wednesday
8.	Last date for Academic Registration	01.08.2019	Thursday
9.	Last date for addition/deletion of courses	02.08.2019	Friday
10.	Mid Term Examination (MTE)	13.09.2019 14.09.2019 16.09.2019 17.09.2019	Friday Saturday Monday Tuesday
11.	Mid-Semester Break	18.09.2019- 22.09.2019	Wednesday- Sunday
12.	Last date for showing MTE answer scripts	24.09.2019	Tuesday
13.	Last date for submission of remaining document(s) by new UG and PG(including PhD) students	30.09.2019	Monday
14.	Annual Convocation – 2019	First week of October (tentative)	
15.	Last date for withdrawal of courses	01.11.2019	Friday
16.	Notification to the students having short attendance up to 07.11.2019 by the Departments/Centres and to send the Final list to Academic Section	08.11.2019	Friday
17.	Last date for Teaching	08.11.2019	Friday
18.	End Term Examination (excluding Sunday & Holiday) (Practical examinations, if any, may be held during last few laboratory days)	13.11.2019- 23.11.2019	Wednesday- Saturday
19.	Last date for communicating marks of all the course components and showing End Term Examination Answer Scripts to students	29.11.2019	Friday
20.	Last date for evaluation of all Projects/ Dissertations/ Seminars	29.11.2019	Friday
21.	Winter vacation for students (except for M. Tech/ IDD final year and PhD students)	30.11.2019 01.01.2020	Saturday Wednesday
22.	Finalization & electronic communication of grades for all courses by the Departments	02.12.2019	Monday
23.	Last date for students to apply for grade modification	03.12.2019	Tuesday
24.	Last date for sending final grades (including grades of PhD) to Academic Section after modifications, if any	04.12.2019	Wednesday
25.	Last date for submission of progress report of the PhD students to Academic Section by the Departments/Centres	04.12.2019	Wednesday
26.	Period for availing vacation leave by faculty	05.12.2019- 01.01.2020	Thursday- Wednesday
27.	Re-examination and Second examination (for Autumn Semester 2019-20)	02.01.2020 04.01.2020	Thursday- Saturday

Teaching days for Autumn Semester 2019-20 (w.e.f. 17.7.2019 to 08.11.2019)

Days	Months																						Less for MTE/Thomso	Total Teaching days PG(I-yr UG)
	July					August					September					October					Nov				
Mon	-	-	-	22	29		5	-	19	26	-	9	**16**	23	30		7	14	21	-		4	**1**	12 (11)
Tue	-	-	-	23	30		6	13	20	27	3	-	**17**	24		1	-	15	22	-		5	**1**	12 (11)
Wed	-	-	17	**24**	31		7	14	21	28	4	11	-	25		-	9	16	23	**30***		6	-	15 (14)
Thu	-	-	18	25		1	8	-	22	29	5	12	-	26		3	10	17	24	**31***		7	-	15(14)
Fri	-	-	19	26		2	9	16	23	30	6	**13**	-	27		4	11	**18**	25		1	8	**2**	14(13)
Sat	-	-	-	**27†**		-	**10†**	-	**24†**	-	-	**14**	-	**28†**		-	**12†**	-			-	-	**1**	**5†**
Total days	**11(7)**					**20(22)**					**17(18)**					**19(20)**					**6(6)**		**5**	**68 (68)**

*Time-table rescheduling (for all the classes)

30.10.2019 (Wednesday) – Monday Time Table
31.10.2019 (Thursday) – Tuesday Time Table

†The following Saturdays would be teaching days **only for I-year BTech/IDD/IMS/IMT/BArch**

27.07.2019 (Saturday) – Tuesday Time Table
10.08.2019 (Saturday) – Monday Time Table
24.08.2019 (Saturday) – Thursday Time Table
28.09.2019 (Saturday) – Friday Time Table
12.10.2019 (Saturday) – Monday Time Table

Details of days used in MTE and THOMSO

MTE (September 13,14,16,17, 2019) - 13.09.2019 - Friday
14.09.2019 - Saturday
16.09.2019 - Monday
17.09.2019 - Tuesday

THOMSO (October 18 – 20, 2019) - 18.10.2019 – Friday (Non-teaching day)

List of Holidays

Id-Ul-Zuha (Bakrid)	12.08.2019	Monday
Independence Day	15.08.2019	Thursday
Ganesh Chaturthi	02.09.2019	Monday
Muharram*	10.09.2019	Tuesday
Mahatma Gandhi's Birthday	02.10.2019	Wednesday
Dashehra (Vijay Dashmi)	08.10.2019	Tuesday
Diwali (Dipawali)	27.10.2019	Sunday
Govardhan Puja	28.10.2019	Monday
Bhai Duj	29.10.2019	Tuesday
Milad-UlNabi or Id-E-Milad (Birthday of Prophet Mohammad)	10.11.2019	Sunday
Guru Nanak's Birthday	12.11.2019	Tuesday
Christmas Day	25.12.2019	Wednesday

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ACADEMIC CALENDAR FOR THE YEAR 2019-20
(Spring Semester)

S.No.	Details	Spring Semester	
		Date	Day
1.	Reporting and Academic Registration of new PhD students	26.12.2019	Thursday
2.	Academic Registration of existing students in the Departments/Centers	02.01.2020	Thursday
3.	Re- examination and Second examination (for Autumn Semester 2019-20)	02.01.2020-04.01.2020	Thursday - Saturday
4.	Commencement of Classes for all students	03.01.2020	Friday
5.	Online subject registration of new PhD students	07.01.2020-08.01.2020	Tuesday Wednesday
6.	Last date for sending the grades ofre-examination/second examination	13.01.2020	Monday
7.	Last date for Academic Registration	14.01.2020	Tuesday
8.	Last date for addition of courses	15.01.2020	Wednesday
9.	Last date for submission of remaining document(s) by new PhD students	17.02.2020	Monday
10.	Mid Term Examination (MTE)	04.03.2020-07.03.2020	Wednesday-Saturday
11.	Mid- Semester Break	09.03.2020-13.03.2020	Monday-Friday
12.	Last date for showing MTE answer scripts	16.03.2020	Monday
13.	Last date for withdrawal of courses	16.04.2020	Thursday
14.	Last date for evaluation of projects/seminars	20.04.2020	Monday
15.	Notification to the students having short attendance upto 20.04.2019 by Departments/Centres and to send the Final list to Academic Section	21.04.2020	Tuesday
16.	Last date of teaching	23.04.2020	Thursday
17.	End Term Examination (excluding Sunday & holidays) (Practical examinations, if any, may be held during last few laboratory days)	24.04.2020 04.05.2020	Friday Monday
18.	Last date for communicating marks of all the course components and showing End Term Examination Answer Scripts to students	09.05.2020	Saturday
19.	Summer Vacation for Students (except for MTech/IDD Final Year and PhD students)	09.05.2020 12.07.2020	Saturday – Sunday
20.	Finalization & electronic communication of grades by the Departments	11.05.2020	Monday
21.	Last date for students to apply for grade modification	14.05.2020	Thursday
22.	Last date for sending final grades (including grades of PhD)to Academic Section after incorporating modifications, if any	15.05.2020	Friday
23.	Last date for submission of progress reports of the PhD students to Academic Section by the Departments/Centres	15.05.2020	Friday
24.	Period for availing vacation leave by faculty	19.05.2020 12.07.2020	Tuesday Sunday
25.	Last date of evaluation & submission of grades for Final Year MTech/MArch/MURP/IDD/IMT Dissertation	26.06.2020	Friday
26.	Re-examination and Second examination (for Spring Semester 2019-20)	13.07.2020 15.07.2020	Monday - Wednesday

Teaching days for Spring Semester 2019-20 (w.e.f. 03.01.2020 to 23.04.2020)

Days	January					February				March					April				Less for MTE/ CON/	Total Teaching days
Monday	-	6	13	20	27	3	10	17	24	2	-	16	23	30		6	**13***	20		**15**
Tuesday	-	7	14	21	28	4	11	18	25	3	-	17	24	31		7	**14***	21	**1**	**14**
Wednesday	-	8	15	22	29	5	12	19	26	**4**	-	18	25		1	8	15	22	**1**	**14**
Thursday	-	9	16	23	30	6	13	20	27	**5**	-	19	26		-	9	16	23	**1**	**13**
Friday	3	10	17	24	31	7	14	-	28	**6**	-	20	27		3	-	-		**1**	**11**
Saturday										**7**					**5***				**1**	**01**
Total days	21					19				18					15				**5**	**68**

***Time-table rescheduling (for all the classes)**

05.04.2020 (Saturday) – Teaching day as per Friday Time Table
13.04.2020 (Monday) – Friday Time Table
14.04.2020 (Tuesday) – Non-teaching day

Details of teaching days used in MTE and COGNIZANCE

MTE (March4-7, 2020) - 04.03.2020 – Wednesday
05.03.2020 – Thursday
06.03.2020 – Friday
07.03.2020 – Saturday

COGNIZANCE (March 27 – 29, 2020) - 27.03.2020 – Friday (Non-teaching day)

List Of Holidays

Republic Day	26.01.2020	Sunday
MahaShivratri	21.02.2020	Friday
Holi	10.03.2020	Tuesday
Ram Navami	02.04.2020	Thursday
Good Friday	10.04.2020	Friday
MahavirJayanti	17.04.2020	Friday
Budh Purnima	07.05.2020	Thursday
Id-ul-Fiter*	24.05.2020	Sunday

*Subject to change on visibility of moon.

Item No. 78.6: **To consider the Revised Report of Grading Rules Review Committee.**

Senate in its 68th meeting decided that a committee be constituted to review the grading system.

The IAPC in its 65th meeting held on Sep 27, 2018 considered the report of the committee and recommended it with modifications **(Appendix 'A')** as under:

1. A+ Grade to be introduced
2. D+ Grade to be removed
3. Moderation of grades to continue with flexibility i.e. the option of moderation be at the discretion of the DFC.

The above is submitted for the consideration and approval of the Senate.

Appendix 'A'
Item No. Senate/78.6

REPORT OF THE GRADE REGULATION REVIEW COMMITTEE

A committee was constituted vide letter no. Acd/5242/Misc-2017 dated June 12, 2017 to review the whole grading system regulations comprising the following members:

1. Prof. Himanshu Joshi, Hydrology - Chairman
2. Prof. N.K. Samadhiya, CED – member
3. Prof. Apurbba Kumar Sharma, MIED – member
4. Prof. Sugata Gangopadhyay, CSE – member
5. Prof. Vipul Rastogi, Physics and ADOAA (Curriculum) – member

Following actions were taken by the committee members:

1. Study of the grade regulation systems of few premier national/international institutes
2. Considering opinion of students and faculty members obtained through mails/personally
3. Considering few cases reported with anomalies

Further, the committee took into account the suggestions from an "Open House" and the "IAPC meeting" and finally resolved to propose the following recommendations:

1. The current grading system should be replaced with the new grading system as presented in Table 1.

2. There should be no limit on the number of students that can be awarded the highest grade A+.

3. Statistical system of grading is preferred for a class size of ≥ 30 students (Table-2). Absolute grading system is preferred for a class size of < 30 students (Table-3). However, a faculty member has a choice of employing the more suitable of the two judiciously.

4. Practice of grade moderation should be mandatory in the case when a course is being offered with more than one teacher teaching different batches. In such a case, the committee chaired by the course coordinator and all the other faculty members teaching the course as members will moderate the grades before final submission. If needed, marks given across different batches may be normalized before the final awarding of grades.

   In all other cases the grade moderation should be optional and can be exercised at the discretion of decision of DFC of the Department.

5. The explanation of different grades, as done now, be discontinued henceforth.

6. In Audit courses, the grades should remain as either "AP (Audit Pass)" or "AF (Audit Fail).

7. No student having 35% or more marks should be awarded the failing grade "F". However, for a student to get a grade D or above in any course, he/she would have to appear in the ETE.

8. A student, who is detained in any course due to short attendance, would be awarded failing grade "FS".

9. The coordinator of any course shall assume full responsibility for award of grades. In case of a concern raised by a sizable number of students, the Chairman Senate may request a committee chaired by Dean Academic Affairs to examine the issue.

TABLE 1: STRUCTURE FOR GRADING OF ACADEMIC PERFORMANCE

Grades	Grade Point
A+	10
A	9
B+	8
B	7
C+	6
C	5
D	4
F	0
FS (Fail due to short attendance)	0
AP (Audit Pass)	-
AF (Audit Fail)	-
I	-
X	-

TABLE 2: SUGGESTED RANGES FOR GRADES USING STATISTICAL METHOD

Lower Range of Marks	Grade	Upper Range of Marks
	A+	$> \overline{X} + 1.5\,\sigma$
$\overline{X} + 1.0\,\sigma <$	A	$\leq \overline{X} + 1.5\,\sigma$
$\overline{X} + 0.5\,\sigma <$	B+	$\leq \overline{X} + 1.0\,\sigma$
$\overline{X}$	B	$\leq \overline{X} + 0.5\,\sigma$
$\overline{X} - 0.5\,\sigma <$	C+	$\leq \overline{X}$
$\overline{X} - 1.0\,\sigma <$	C	$\leq \overline{X} - 0.5\,\sigma$
$\overline{X} - 0.5\,\sigma <$	D	$\leq \overline{X} - 1.0\,\sigma$
	F	$\leq \overline{X} - 1.5\,\sigma$

TABLE 3: SUGGESTED RANGES FOR GRADES BASED ON ABSOLUTE MARK SYSTEM

The award of grades on absolute marks out of 100 may be made as follows:

Marks	Grade	Marks
91 ≤	A+	≤ 100
82 ≤	A	≤ 90
73 ≤	B+	≤ 81
64 ≤	B	≤ 72
55 ≤	C+	≤ 63
46 ≤	C	≤ 54
35 ≤	D	≤ 45
-	F	≤ 34

Item No. 78.7: To consider the modified minimum eligibility criteria for admission in Ph.D. programme as proposed by Department of Metallurgical and Materials Engineering and Department of Architecture and Planning.

IRC in its 28th meeting held on March 28, 2019 took note of the changes proposed by the two departments in the minimum eligibility criteria for admission in Ph.D. programme (**Appendix 'A'**).

The above is submitted for the consideration and approval of the Senate.

Appendix 'A'
Item No. Senate/78.07

A. Department of Metallurgical & Materials Engineering

Existing	Proposed
B.Tech / M.Tech or equivalent relate to the following disciplines: Metallurgical Engg, Materials Engg, Nanotechnology, Engg Physics, Engg Chemistry, Ceramics, Polymers, Corrosion, Mechanical, Production & Industrial Engg., Chemical Engg. and Electrochemical Engg. Or 1. M.Sc. degree in Physics, Chemistry, Materials Science. 2. Candidates with a M.Sc. degree , Mathematics as a subject at B.Sc. degree level is an essential requirement **Note: Candidates having a degree in Industrial Engineering only, shall not be eligible for admission to the Doctor of Philosophy programme in the Department of Metallurgical and Material Engg.**	**Candidates with Bachelors or Masters Degree (B.E./B.Tech./M.E./M.Tech) in Metallurgical Engineering, Metallurgical and Materials Engineering, Materials Science and Engineering, Ceramic Engineering, Polymer Engineering.**

B. Department of Architecture & Planning

Existing	Proposed
Master's Degree in Architecture in any of the specializations offered by recognized Institutions of Architecture/ Master's Degree in Building Science/ Technology with a Bachelor's Degree in Architecture/ Master's Degree in Planning in any of the specializations offered by the recognized Institutions of Planning with a Bachelor's Degree in either Architecture or Planning (B. Planning) or Civil Engineering.	**1. Bachelor's Degree in Architecture or Planning followed by Master's Degree in any specialization offered by a recognized Institution.** **2. Bachelor's Degree in Civil Engineering followed by Master's Degree in any specialization of Planning offered by a recognized Institution.**

Item No. 78.8: To consider the request of two students regarding extension in time for the submission of thesis.

The IRC in its 28th meeting held on March 28, 2019 has discussed the request of two Ph.D. students regarding extension in time for submitting the thesis and observed that both the students have availed the maximum extension in time i.e. 6 years admissible for the Full-Time students. Name of Mr. Ararso Beyene Woyessa has been struck-off from the rolls of the institute. The IRC recommended the cases as follows:

a. Mr. Rajavel Muthaiah V. M., Enrolment No. 12924005, Ph.D. student MMED, can be allowed as the final SRC is over and student is expected to submit the thesis by April 2019.

b. Mr. Ararso Beyene Woyessa, Enrolment No. 12910001, Ph.D. student, Department of Architecture & Planning, may be allowed going by the personal problems and medical condition faced by the student.

The above is submitted for the consideration and approval of the Senate.

Item No. 78.9: To consider the recommendations of DAPC and DRC, Deptt. of Earth Sciences, to give one time exception to Research Scholars who took UG level courses in Autumn / Spring semester 2018-19 to complete course credit requirement for Ph.D. programme.

SRCs of Ph.D. students registered in Department of Earth Sciences had sent recommendations regarding courses to be taken by Ph.D. students but these courses were found to be of UG level.

As per Ph.D. Rules & Regulations R.4 Table-1, **(Appendix 'A')** courses from the existing PG level and/or pre-Ph.D. courses offered by own Department/other Departments are to be taken as a course work requirement for Candidacy to Ph.D. programme.

The matter was discussed in the 24th IRC in its meeting held on 10.12.2018 and the IRC recommended that these courses shall be considered as Audit courses and students should be asked to take PG or Pre-Ph.D. courses for completing the course work requirement for candidacy. The decision was conveyed to the department. **(Appendix 'B').**

Department of Earth Sciences again requested through DAPC and DRC to allow Ph.D. students to take UG level courses. Recommendations of DAPC and DRC, Department of Earth Sciences, were again placed before the 27th IRC on 20.02.2019 but the IRC, after detailed deliberation did not approve the same. It was noted that out of 15 students 10 students have completed the course credits in Autumn semester and 5 students have again taken UG level courses in Spring semester even though the correction was intimated to the department in December.

The above is submitted for the consideration and approval of the Senate.

Appendix 'A'
Item No. Senate/78.9

R.4: Table-1 COURSE CREDIT REQUIREMENTS

SI. No.	Candidate Having	Range of Credit Requirements	Remarks
1.	M.Tech, M.Arch./ MURP, MCA or M.Tech. (Integrated/ IDD) or Equivalent Degree	– minimum 3 theory courses or minimum of 9 credits theory courses – should earn 2 more credits by delivering seminar	Course From the existing M.Tech and/or pre-Ph.D. courses offered by own Deptt./ other Deptts.
2.	M.Sc/ M.A./ M.B.A. or equivalent admitted to Science/ HSS/ Management department	– 12-15 credits theory courses. – should earn 2 more credits by delivering seminar	Course From the existing PG level and/or pre-Ph.D. courses offered by own Deptt./ other Deptts.
3.	B.Tech. or equivalent, or M.Sc. or equivalent, admitted to anyone of the Engg. Disciplines	– 34-38 credits equivalent to credits earned by M.Tech. students – should earn 2 more credits by delivering seminar	Course Form the existing PG level and/or pre-Ph.D. courses offered by own Deptt./ other Deptts.

NOTE : The research scholars having M.Tech./MCA or equivalent degree have to take either minimum three theory courses (irrespective of credits) or minimum 9 credits theory courses (may be two courses, one of 4 credits and another of 5 credits).

Item No. 05
Appendix-B

भारतीय प्रौद्योगिकी संस्थान रूड़की
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

नं. रिसर्च /३३१ /आई.आर.सी.–24
No. Research/ 331 /IRC-24

दिनांकः दिसम्बर 18, 2018
Dated: 18th December, 2018

NOTIFICATION

Subject: Requirement of PG/Pre-Ph.D. level courses for Candidacy of Ph.D. Research Scholars.

The 24th IRC in its meeting held on 10th December, 2018 vide item No. 24.2.5 did not accept the recommendation of Students Research Committees (SRCs) from few departments regarding waiving-off the requirement of PG level courses and allow students to study UG level courses as a requirement of pre-Ph.D. courses.

18/12/18
Assistant Registrar (Evaluation)

Copy forwarded through email to:

1. All Faculty members.
2. Assistant Registrar to Director for Director's kind information.
3. All Ph.D. Research Scholars.
4. Channel-i.

Item No. 78.10: To consider the cut-off rank for James Thomason Scholarship (JTS) for 2019-2020.

JTS was initiated in 2017-18 to attract top ranking students to IIT Roorkee.

The following table gives some background information:

Year 2015		Year 2016	
CSE	Opening Rank 308 Closing Rank 559	CSE	Opening Rank 294 Closing Rank 482
ECE	Opening Rank 886	ECE	Opening Rank 948

In 2017, the following criteria was used for awarding JTS :

(i) Students admitted within AIR of 300 and
(ii) Any student who is the first student to take admission in a branch and his/her AIR is within 500.

As a result, 5 students with AIR 268, 282, 284, 294 and 300 joined but all the students who had AIR within 500 took admission in CSE. The opening and closing ranks for CSE was 268 and 449, respectively while opening rank for ECE was 833. Thus, the second clause above was not used.

In 2018, the second clause was deleted and 7 students with AIR less than 300 joined CSE. Their ranks were 278, 280, 290, 293, 295, 296 and 299.

During the five year period 2012-2016, only one student with AIR less than 300 had taken admission. Thus, there is an improvement in opening ranks in 2017 and 2018.

It is proposed that All India Rank cut off for awarding JTS for year 2019-2020 be kept at 275.

The above is submitted for the consideration and approval of the Senate.

Item No. 78.11: To consider the remaining clauses of Part-II: Ph.D. Procedures as proposed by Prof. Manish Shrikhande Committee on Ph.D. Rules & Regulations.

Item, as emailed on 14.02.2019, will be displayed during the meeting.

Item No.78.12: **To ratify the award of provisional Ph.D. Degree certificates to the students who have completed the requirements for the award of Ph.D. Degree in various disciplines w.e.f. 02.01.2019 to date.**

The list is presented in **Appendix 'A'.**

Third Senate approved PDC List

Sl. No.	Name	Deptt.	Topic	Supervisor	Examiner (For./Ind.)	PDC Date
1	Mr. Ali Abbas	AHEC	INVESTIGATIONS OF PARAMETERS AFFECTING DRAFT TUBE PERFORMANCE	Prof. Arun Kumar	Prof. T. Staubli, Hochschule Luzern, Switzerland Prof. Dhiman Chatterjee, IIT Madras Prof. Vishnu, MANIT Bhopal	15.01.19
2	Ms. Harshit Sosan Lakra	AR	INDIGENOUS COMMUNITIES' PERCEPTION OF ASSOCIATION WITH A PLACE, CULTURAL CAPITAL AND ENABLING ENVIRONMENT IN AN URBAN CONTEXT	Prof. Pushplata	Prof. Sandeep Agrawal, Univ. of Alberta, Canada Prof. Mahavir, School of Planning & Arch., Delhi Prof. Kujur Joseph Marianus, Ranchi	06.03.19
3	Ms. Pooja Kesari	BT	STRUCTURAL AND FUNCTIONAL STUDIES OF PLANT PROTEINS	Prof. Pravindra Kumar	Prof. Christian Betzel, Hamburg Univ., Germany Prof. Amit Kumar Das, IIT Kharagpur Prof. Renu Deswal, Delhi University, Delhi	16.02.19
4	Mr. Atin Sharma	BT	STUDIES ON PHYSIOLOGICAL IMPORTANCE OF HFQ AND SRNA TARGETS IN *ACINETOBACTER BAUMANNII*	Prof. Ranjana Pathania	Prof. Ayush Kumar, Manitoba University, Canada Prof. Anirban Banerjee, IIT Bombay Prof. D. Chakravortty, IISc Bangalore	11.02.19
5	Mr. Harvijay Singh	BT	STUDIES ON ALPHAVIRUS CYSTEINE PROTEASE FOR ANTIVIRAL DRUG DISCOVERY	Prof. Shally Tomar	Prof. Richard J. Kuhn, Purdue University, USA Prof. M.R.N. Murty, IISc Bangalore Prof. Punit Kaur, AIIMS New Delhi	10.01.19
6	Ms. Anju Kumari	BT	FUNCTIONALIZED MEMBRANE WITH LIPID BILAYER FOR IMMOBILIZED ENZYMATIC SYSTEMS	Prof. Saurav Datta	Prof. Manish Kumar, Park University, USA Prof. G. Pugazhenthi, IIT Guwahati Prof. Anupam Shukla, IIT Delhi	23.01.19
7	Ms. Gunjan Saini	BT	STUDIES ON SOLUTE BINDING PROTEINS FROM *CANDIDATUS* LIBERIBACTER ASIATICUS	Prof. A. K. Sharma	Prof. M. Narayan, Texas University, USA Prof. Punit Kaur, AIIMS New Delhi	15.01.19
8	Mr. Bhanendra Singh	BT	BIODETOXIFICATION OF LIGNOCELLULOSIC HYDROLYSATE LIQUOR TO IMPROVE BIOFUEL PRODUCTION	Prof. Saurav Datta	Prof. Seth W. Snyder, Northwestern Univ., USA Prof. Rintu Banerjee, IIT Kharagpur	08.03.19
9	Mr. Rajat Mudgal	BT	STUDIES OF SUBSTRATE-BASED INHIBITORS TARGETING NON-STRUCTURAL PROTEINS OF ALPHAVIRUSES	Prof. Shailly Tomar	Prof. Richard W. Hardy, Indiana Univ., USA Prof. Manidipa Banerjee, IIT Delhi Prof. Savita Yadav, AIIMS New Delhi	22.03.19
10	Ms. Archana Mishra	BT	BIOETHANOL PRODUCTION BY FRACTIONAL HYDROLYSIS AND CO-CULTURE FERMENTATION	Prof. Sanjoy Ghosh	Prof. Abdel Ghaly, Nova Scotia, Canada Prof. Latha Rangan, IIT Guwahati	27.03.19
11	Mr. Bandaru Venkata Ramanaiah	CH	ENERGY CONSERVATION IN COAL BASED SPONGE IRON CLUSTER USING	Prof. Shabina Khanam	Prof. T. Mojozi, Wits University, RSA Prof. S. Bandyopadhyay, IIT Bombay	08.01.19

			TOTAL SITE INTEGRATION		Prof. Ramagopal Uppaluri, IIT Guwahati	
12	Ms. Iram Parveen	CY	**SYNTHESIS AND BIOLOGICAL APPLICATIONS OF FLAVONOID BASED NATURAL PRODUCTS**	Prof. Naseem Ahmed	Prof. Mushfiquddin Khan, Medical University,USA Prof. M. Ravikanth, IIT Bombay Prof. Faiz Ahmed Khan, IIT Hyderabad	20.02.19
13	Mr. Nishant Gautam	CY	**ENERGY STORAGE MATERIALS: NEW TRANSITION METAL OXIDES, OXY-FLUORIDES AND PHOSPHATES**	Prof. T. K. Mandal	Prof. Y. Shirley Meng, California University, USA Prof. U. V. Varadaraju, IIT Madras Prof. N. Munichandraiah, IISc Bangalore	11.02.19
14	Ms. Manju Bala	CY	**STUDIES ON NEW RUTHENIUM COMPLEXES AND THEIR REACTIVITIES**	Prof. Kaushik Ghosh	Prof. Dixneuf Pierre H., CNRS University, France Prof. Sabuj K. Kundu, IIT Kanpur Prof. G. K. Lahiri, IIT Bombay	07.03.19
15	Mr. Shray Pathak	CE	**MULTI-CRITERIA DECISION ANALYSIS FOR IDENTIFYING STORMWATER HARVESTING SITES**	Prof. R. D. Garg Prof. C. S. P. Ojha	Prof. V. Lakshmi, South Carolina Univ., Columbia Prof. Onkar Dikshit, IIT Kanpur	31.01.19
16	Ms. Murkonda Pavani	CE	**ANALYSIS OF PLATES ON REINFORCED EARTH BEDS**	Prof. Priti Maheshwari	Prof. Braja M. Das, State University, USA Prof. Gali Madhavi Latha, IISc Bangalore Prof. Sarvesh Chandra, IIT Kanpur	31.01.19
17	Mr. Pradeep Kumar	CE	**PAVEMENT SURFACE CONDITION EVALUATION AND CLASSIFICATION USING GEOSPATIAL TOOLS**	Prof. P. K. Garg Prof. M. Parida	Prof. M. Kappas, GIS Remote Sensing, Germany Prof. Rajan Choudhary, IIT Guwahati Dr. Sameer Saran, IIRS Dehradun	18.03.19
18	Mr. Vimal Kumar	CE	**BEHAVIOUR OF PRESTRESSED CONCRETE SLABS UNDER IMPACT LOADING**	Prof. M. A. Iqbal Prof. A. K. Mittal	Prof. Norman Jones, University of Liverpool, UK Prof. P. Venkitanarayan, IIT Kanpur Prof. R. Velmurugan, IIT Madras	18.03.19
19	Ms. Swati Bhave	CE	**EXPERIMENTAL STUDY ON HYDRAULICS OF BOTTOM RACKS WITH T-SHAPE BARS**	Prof. A. Ahmad	Prof. Stefano Lanzoni, Univerrsita di Padova, Italy Prof. Deo Raj Kaushal, IIT Delhi Prof. Rajesh Srivastava, IIT Kanpur	08.03.19
20	Ms. Sonali Bhowmik	CE	**ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS ON CONCRETE MEMBERS UNDER FATIGUE LOADING**	Prof. Sonalisa Ray	Prof. J. Saliba, Universite de Bordeaux, France Prof. K. Darunkumar Singh, IIT Guwahati	14.03.19
21	Mr. Aditya Singh Rajput	CE	**SEISMIC EVALUATION AND UPGRADATION OF CORRODED CONFINED REINFORCED CONCRETE COLUMNS**	Prof. Umesh K. Sharma	Prof. ILdiko Mert, Institute Mat. Tech., Austria Prof. Yogesh M. Desai, IIT Bombay	25.03.19
22	Mr. Rajkumar Saini	CSE	**EXPLOITING LOCAL INFORMATION FOR TRAJECTORYCLASSIFICATION UNDER SURVEILLANCE**	Prof. Partha Pratim Roy	Prof. K.C. Santosh, South Dakota University, USA Prof. Phalguni Gupta, IIT Kanpur	31.01.19
23	Ms. Shivani Sharma	CSE	**PRIVACY PRESERVING SENSITIVE PATTERN HIDING TECHNIQUES FOR BIG DATA**	Prof. Durga Toshniwal	Prof. Imre J. Rudas, Obuda University, Hungary Prof. S. K. Rath, NIT Rourkela	24.01.19
24	Mr. Shivesh Tripathi	CTRN	**DESIGN, ANALYSIS AND CHARACTERIZATION OF BASIC**	Prof. M. Parida Prof. N. P. Pathak	Prof. Sagar Naik, Waterloo University, Canada Prof. Akhilesh Mohan, IIT Kharagpur	30.01.19

			BUILDING BLOCKS OF SOFTWARE DEFINED RADIO BASED INTELLIGENT TRANSPORT SYSTEMS FOR 5 G AND BEYOND			
25	Ms. Rimpi Dhiman	ES	**U-Pb GEOCHRONOLOGICAL AND GEOCHEMICAL EVOLUTION OF DHAULADHAR AND DALHOUSIE GRANITES OF HIMACHAL HIMALAYAS**	Prof. Sandeep Singh	Prof. M. Leech, San Francisco State Univ., USA Prof. Mallickarjun Joshi, IIT Varanasi Prof. C. S. Dubey, University of Delhi, Delhi	14.03.19
26	Ms. Vaneeta Devi	EQ	**FREQUENCY PATTERN ANALYSES OF GROUND MOTION HISTORY**	Prof. M. L. Sharma	Prof. Mario Ordaz, Nacional Autonoma Univ., Mexico Prof. T. G. Sitharam, IISc Bangalore Prof. S. S. Teotia, Kurukshetra Univ., Kuruksetra	01.01.19
27	Mr. Bhavesh Pandey	EQ	**SITE CHARACTERIZATION AND ATTENUATION STUDIES FOR NORTHERN INDIA**	Prof. R. S. Jakka	Prof. Chun-Hsiang Kuo, NCREE, Taiwan Prof. T. G. Sitharam, IISc Bangalore	01.01.19
28	Mr. Gaurav Kumar	EQ	**DEVELOPMENT AND OPTIMIZATION OF CONTROLLERS FOR MITIGATION OF SEISMIC VIBRATIONS**	Prof. R. S. Jakka Prof. Ashok Kumar	Prof. S. M. Yang, National Cheng Kung Univ., Taiwan Prof. R. S. Jangid, IIT Bombay	16.02.19
29	Mr. Amit Goyal	EQ	**SEISMIC EVALUATION OF BLOCK MASONRY INTERLINKED WITH VISCOELASTIC LINK ELEMENTS**	Prof. Pankaj Agarwal	Prof. Paolo Morandi, E.C.T.R.E.E., Italy Prof. Durgesh C. Rai, IIT Kanpur	21.02.19
30	Mr. Neeraj Kumar	EQ	**DYNAMIC SITE-CITY-INTERACTION ANALYSIS OF STRUCTURES INURBAN ENVIRONMENT**	Prof. J. P. Narayan	Prof. H. Fujiwara, NRIESDR, Japan Prof. P. N. Singha Roy, IIT Kharagpur Prof. P. K. Khan, IIT (ISM) Dhanbad	21.02.19
31	Mr. Dhiraj Raj	EQ	**SEISMIC BEHAVIOUR OF FOUNDATIONS AND BUILDINGS ON SLOPES**	Prof. Yogendra Singh	Prof. Behzad Fatahi, University of Tech.,Australia Prof. Jyant Kumar, IISc Bangalore	11.02.19
32	Mr. Santosh K. Singh	EE	**PERFORMANCE ANALYSIS OF UPS INVERTERS SYSTEMS**	Prof. S. G. Choudhuri	Prof. Ambrish Chandra, ETS Canada Prof. Bhim Singh, IIT Delhi Prof. H. M. Suryawanshi, VNIT Nagapur	07.03.19
33	Mr. Yogesh K. Sariya	EE	**FUNCTIONAL NETWORK CONNECTIVITY ANALYSIS OF HUMAN BRAIN**	Prof. R. S. Anand	Prof. Lucina Q. Uddin, University of Miami, USA Prof. Vikram M. Gadre, IIT Bombay Prof. B. Thomas, Medical College, Kerala	25.03.19
34	Mr. Dinesh	E&CE	**IMAGE FORENSICS BASED ON JPEG COMPRESSION ARTIFACTS**	Prof. Vinod Pankajakshan	Prof. Mauro Barni, Siena University, Italy Prof. Prabin Kumar Bora, IIT Guwahati Prof. Umapada Pal, ISI Kolkata	03.01.19
35	Ms. Neetu Joshi	E&CE	**GRAPHENE BASED PLASMONIC INTEGRATED CIRCUITS FOR TERAHERTZ APPLICATIONS**	Prof. N. P. Pathak	Prof. Berardi Sensale Rodriguez, Utah Univ., USA Prof. K. J. Vinoy, IISc Bangalore Dr. Akhilesh Jain, RRCAT Indore	12.02.19
36	Mr. Zahir Ahmed Ansari	E&CE	**Robust Algorithms for online visual tracking systems**	Prof. M. J. Nigam	Prof. Tsu-Chin (T-c) Tsao, HSSEAS, USA Prof. S. K. Nagar, IIT (BHU) Varanasi	23.02.19

37	Mr. Virnce Vimal	E&CE	**NOVEL ALGORITHMS FOR IMPROVING LIFE TIME AND TAKELING LINK RUPTURE IN WIRELESS NETWORKS**	Prof. M. J. Nigam	Prof. Vivek Jain, Res. & Tech. Centre, USA Prof. Vimal Bhatia, IIT Indore Prof. Neetesh Purohit, IIIT Allahabad	12.03.19
38	Ms. Sasmita Dash	E&CE	**DESIGN AND ANALYSIS OF GRAPHENE PLASMONIC ANTENNAS FOR TERAHERTZ APPLICATION**	Prof. A. Patnaik	Prof. Arokiaswami Alphones, NTU Singapore Prof. S. A. Ramakrishna, IIT Kanpur Prof. K. J. Vinoy, IISc Bangalore	28.01.19
39	Mr. Praveen Jaraut	E&CE	**DIGITAL PREDISTORTION LINEARIZATION FOR MULTI-BAND/MULTI-CHANNEL SOFTWARE DEFINED TRANSMITTERS**	Prof. Meenakshi Rawat	Prof. D. Schreurs, Kasteelpark Arenberg, Belgium Prof. Manav Bhatnagar, IIT Delhi	06.03.19
40	Ms. Meenakshi Awasthi	E&CE	**ENERGY EFFICIENT COOPERATIVE SPECTRUM SENSING IN COGNITIVE RADIO NETWORKS**	Prof. Vijay Kumar Prof. M. J. Nigam	Prof. J.Ben Othman, University of Paris 13,France Prof. Vimal Bhatia, IIT Indore Prof. Prabhat K. Upadhyay, IIT Indore	12.03.19
41	Ms. Mandakini	HSS	**CRITICAL ANALYSIS OF WOMEN'S DEPICTION IN MODERN INDIAN PAINTINGS**	Prof. Ila Gupta Prof. P. Jha	Prof. Subhash Kak, USA Prof. Anupama Sharma, MANIT Bhopal Prof. Santosh Kumar Misra, PMCA Odisha	16.02.19
42	Mr. Ashwini Kumar	HSS	**LATERALITY AND COGNITIVE INTERFERENCE IN STROOP LIKE TASKS AMONG RIGHT AND NON-RIGHT HANDERS**	Prof. R. M. Singh Prof. Indiwar Misra	Prof. Fernand Gobet, Liverpool University, UK Prof. H. S. Asthana, IIT (BHU) Varanasi Prof. Nandita Babu, DU Delhi	16.02.19
43	Mr. Akarsh Arora	HSS	**MEASURING POVERTY IN UTTAR PRADESH, INDIA: FROM UNIDIMENSIONAL TO MULTIDIMENSIONAL APPROACH**	Prof. S. P. Singh	Prof. Nanak Kakwani, Univ. of New South Wales, Australia Prof. Pushpa Trivedi, IIT Bombay	22.03.19
44	Ms. Hansika Singhal	HSS	**PSYCHOLOGICAL CAPITAL AS A PREDICTOR OF SUBJECTIVE WELL-BEING AND CAREER COMMITMENT**	Prof. Renu Rastogi	Prof. Tojo Thatchenkery, George Mason Univ.,USA Prof. Meenakshi Gupta, IIT Bombay	28.03.19
45	Ms. Kumari Soni	HSS	**IMPACT OF PSYCAPON EMPLOYEE ENGAGEMENT & ORGANIZATIONAL EFFECTIVENESS**	Prof. Renu Rastogi	Prof. Bahaudin G.Mujtaba, Nova Southeastern Univ.,USA Prof. Pooja Purang, IIT Bombay Prof. Nachiketa Tripathi, IIT Guwahati	21.02.19
46	Mr. Vikram Kumar	HY	**HYDROLOGICAL RESPONSE OF AN EXPERIMENTAL WATERSHED OF LESSER HIMALAYA**	Prof. Sumit Sen	Prof. Harry Dixon, Centre Ecology & Hydology,UK Prof. Prabhat K. Singh Dikshit, IIT Varanasi	14.03.19
47	Ms. Jyoti Jaiswal	IIC	**STUDIES ON OPTICAL PROPERTIES OF SPUTTER-DEPOSITED NANOSTRUCTURED THIN FILMS**	Prof. Ramesh Chandra	Prof. Yogendra K. Mishra, Kiel University, Germany Prof. Parinda Vasa, IIT Bombay	24.01.19
48	Mr. Himanshu Gupta	MS	**ANALYSIS AND DESIGN OF A FRAMEWORK FOR GREEN INNOVATION IMPLEMENTATION IN SMEs**	Prof. M. K. Barua	Prof. Charbel J. Chiappetta Jobbour, MBS France Prof. B. K. Mohanty, IIM Lucknow	21.02.19

49	Mr. Shashi Kant	MS	**A STUDY OF ORGANIZATIONAL EVIDENCES OF GANDHIAN MANAGEMENT PERSPECTIVE WITH SPECIAL REFERENCE TO BHEL**	Prof. Vinay Sharma	Prof. Siva Prasad Ravi, Nipissing Univ., Canada Prof. Sujoy Bhattacharya, IIT Kharagpur	08.03.19
50	Mr. Sumit Mishra	MS	**VALUE REALIZATION IN MARKETING THEORY: AN ANCIENT INDIAN PERSPECTIVE**	Prof. Vinay Sharma	Prof. S. Bruce Thomson, Federation Univ. Australia Prof. Devashish Das Gupta, IIM Lucknow Prof. Sanjeev Prashar, IIM Raipur	22.03.19
51	Ms. Anamika Singh	MS	**DETERMINANTS OF LIQUIDIFY IN INDIAN COMMERCIAL EVALUATION BANKS: AN FLMPIRICAL EVALUATION**	Prof. A. K. Sharma	Prof. Hafez Abdo, Sheffield Hallam University, UK Prof. B. V. Phani, IIT Kanpur Prof. Surendra S. Yadav, IIT Delhi	29.03.19
52	Mr. Chirra Sricharan	MIE	**SCF STUDY UNDER SALES PROMOTIONS IN AN AUTOMOBILE INDUSTRY**	Prof. Dinesh Kumar	Prof. Nachiappan Subramanian, Sussex Univ.,UK Prof. Sushil, IIT Delhi Prof. A. Subash Babu, IIT Bombay	01.01.19
53	Mr. Satish Kumar	MIE	**ACTIVE DYNAMIC ANALYSIS AND CONTROL OF SPACE BASED ADAPTIVE MEMBRANE STRUCTURES**	Prof. S. H. Upadhyay	Prof. D. Dane Quinn, Akron University, USA Prof. Satish Chandra Jain, IIT Mandi Dr. B. S. Manjul, ISRO Ahmedabad	08.02.19
54	Mr. Gaurav Sharma	MIE	**STUDIES ON METALLURGICAL AND MECHANICAL BEHAVIOR OF DIFFUSION BONDED STEEL JOINTS**	Prof. D. K. Dwivedi	Prof. Dulce Rodrigues, Coimbra Univ., Portugal Prof. Amitava De, IIT Bombay Prof. S. Aravindan, IIT Delhi	31.01.19
55	Mr. V. M. Suntharavel Muthaiah	MME	**THERMAL STABILITY AND MECHANICAL PROPERTIES OF FE-CR NANOSTRUCTURES PREPARED BY MECHANICAL ALLOYING FOLLOWED BY SPARK PLASMA SINTERING**	Prof. Suhrit Mula	Prof. Pratik Kumar Ray, Lowa State University, USA Prof. B. S. Murty, IIT Madras Prof. R. Jayaganthan, IIT Madras	16.02.19
56	Mr. Shailesh Kumar Chaurasia	MME	**MECHANICAL AND TRIBOLOGICAL PROPERTIES OF POWDER FORGED Fe-P ALLOYS**	Prof. Ujjwal Prakash	Prof. Margaret M. Stack, Strathclyde University, UK Prof. M. Kamaraj, IIT Madras Prof. Harpreet Singh, IIT Ropar	11.02.19
57	Mr. Umesh Chandra Bind	NT	**ION IMPLANTATION AND CHEMICAL MODIFICATION OF CuO NANOPARTICLES AND THEIR ELECTROCHEMICAL APPLICATIONS**	Prof. R. K. Dutta	Prof. Yasuaki Einaga, Keio University, Japan Prof. Raghunath Acharya, BARC Mumbai	04.01.19
58	Ms. Pallavi Gupta	NT	**FUNCTIONALIZED POLYMERIC SCAFFOLDS FOR NEURAL TISSUE ENGINEERING**	Prof. S. K. Nath Prof. Debrupa Lahiri	Prof. S. Venkatraman, NTU Singapore Prof. Ashok Kumar, IIT Kanpur Prof. Kaushik Chatterjee, IISc Bangalore	26.02.19
59	Ms. Swati	PH	**ROLE OF ISOPIN IN HEAVY AND NEUTRON-RICH NUCLEI**	Prof. P. Van Isacker	Prof. P. Van Isacker, GANIL France Prof. A. Shrivastava, BARC Mumbai Prof. Rudrajyoti Palit, TIFR Mumbai	01.01.19
60	Mr. Gaurav Bharti	PH	**RESPONSE OF NEUTRAL ATMOSPHERE ANDIONOSPHERE TO VARIOUS GEOPHYSICAL CONDITIONS**	Prof. M. V. Sunil Krishna	Prof. Gordon G. Shepherd, York Univ., Canada Dr. Gurbax S. Kaljina, IIG Mumbai Dr. S. Sridharan, NARL Tiruptai	12.03.19

61	Mr. Madhab Bera	PPE	**STRUCTURE-PROPERTY RELATIONSHIPS IN GRAPHENE BASED POLYMER NANOCOMPOSITES**	Prof. P. K. Maji	Prof. Suprakas Sinha Ray, DST-CSIR, South Africa Prof. Arup R. Bhattacharyya, IIT Bombay Prof. Niranjan Karak, Tezpur Univ., Sonitpur	02.02.19
62	Mr. Sauraj	PPE	**SYNTHESIS AND BIOEVALUALTION OF XYLAN BASED PRODRUGS FOR COLON CANCER TREATMENT**	Prof. Y. S. Negi	Prof. Thomas Heinze, Friedrich Schiller Univ., Gerrmany Prof. Veena Koul, IIT Delhi Prof. Veena Choudhary, IIT Delhi	13.03.19
63	Mr. Sandeep Shukla	WRD	**SNOWPACK ESTIMATION AND ITS IMPACT ON RIVER FLOW REGIME**	Prof. M. L. Sharma Dr. Sanjay K. Jain	Prof. Ian Holman, Cranfield University, UK Dr. S. P. Aggarwal, IIRS Dehradun Prof. A. P. Dimri, JNU Delhi	18.01.19

भारतीय प्रौद्योगिकी संस्थान रूड़की
रूड़की – 247 667 (भारत)
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE - 247 667 (INDIA)

सीनेट की अठत्तरवी बैठक हेतु अनुपूरक कार्य सूची
SUPPLEMENTARY AGENDA FOR THE
78th MEETING OF THE SENATE

बैठक सं0	: अठत्तरवी
MEETING NO.	**: 78th**
स्थान	: सीनेट हॉल, भा0प्रौ0सं0 रूड़की
VENUE	**: Senate Hall, IIT Roorkee**
दिनांक	: 10 अप्रैल 2019
DATE	**: 10th April 2019**
समय	: 3.30 बजे अपरान्ह
TIME	**: 3.30 P.M.**

भारतीय प्रौद्योगिकी संस्थान रूड़की
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
रूड़की 247 667
ROORKEE – 247 667

अनुपूरक कार्यसूची/ SUPPLEMENTARY AGENDA

मुद्दा सं0/ **Item No.**	विवरण/**Particulars**	पृश्ठ/ **Page(s)**
78.13	प्रोजक्ट स्टाफ का पीएचडी प्रोग्राम में प्रवेश पात्रता के मानदंडों और चयन प्रक्रिया में संशोधन पर विचार करना। To consider the modification in the eligibility criteria and selection process for admission of a Project staff in Ph.D. programme.	41
78.14	77वी सीनेट द्वारा निर्देशित पीएचडी प्रोग्राम की उम्मीदवारी के लिए कोर्स क्रेडिट आवश्यकताओं पर विचार करना। To consider the course credit requirements for candidacy to a Ph.D. programme as directed by the 77th Senate.	42
78.15	शैक्षणिक वर्ष 2019–20 के लिए पीएचडी सहित यूजी और सभी मास्टर कार्यक्रमों के सीट मैट्रिक्स पर विचार करना। To consider the Seat Matrix for UG and all Master Programmes including Ph.D. for the academic year 2019-20.	43-49
78.16	जानपद इंजिनियरिगं विभाग के एमटेक (परिवहन) स्कीम में संशोधन के प्रस्ताव पर विचार करना। To consider the proposal of Department of Civil Engineering regarding modification in the scheme of M. Tech. (Transportation).	50-75
78.17	जल एवं नवीकरणीय ऊर्जा विभाग के निम्नलिखित प्रस्तावों पर विचार करना: (अ) एमटेक (एएचईएस) में प्रवेश पात्रता के लिए "इंस्ट्रुमेंटेशन इंजीनियरिग" को जोडना। (आ) बीटेक छात्रों के लिए एक नया ओपन इलेक्टिव कोर्स (ओईसी) आईएएच–303: सोलर फोटोवोल्टिक टैक्नोलोजी और एपलिकेशन्स शुरू करना ।	76-77

	To consider the following proposals of Department of Hydro and Renewable Energy: (a) Addition of "Instrumentation Engineering" as eligibility criteria for the admission in M. Tech. (AHES). (b) Introduction of a new Open Elective Course (OEC) for B. Tech. students – (IAH-303 : Solar Photovoltaic Technology and Applications)	
78.18	विभिन्न पुरस्कारों के लिए पुरस्कार समितियों की सिफारिशों पर विचार और अनुमोदन करना। To consider and approve the recommendations of award committees for various awards.	78
78.19	विभिन्न गैर दीक्षांत पुरस्कारों के लिए पुरस्कार विजेताओं पर विचार और अनुमोदन करना। To consider and approve the awardees for various non-convocation awards.	79-86
78.20	टाइम मैनेजमेंट के लिए एक पुरस्कार पर विचार और अनुमोदन करना। To consider and approve an award for Time Management.	87
78.21	छात्रों के अनुरोधो पर विचार करना। (अ) अपूर्ण न्यूनतम एसजीपीए की वस्तुस्थिति में कार्यक्रम जारी रखना (ब) मेडिकल ग्राउंड पर सेमेस्टर विड्राल (स) अनुमेय सीमा ौष्घात विस्तार, और (द) द्वितीय दया अपील To consider the requests of students regarding (A) continuation of program in spite of not fulfilling minimum SGPA, (B) semester withdrawal on medical ground, (C) extension beyond permissible limit and (D) 2nd mercy appeal.	88-93
78.22	विदेशी नागरिकों के लिए एमएससी कार्यक्रम में प्रवेश प्रावधान और पात्रता मानदंड के प्रस्ताव पर विचार करना। To consider the proposal for provision of admission of foreign nationals in M.Sc. programmes and eligibility criteria.	94
78.23	प्रवेश में ईडब्लूएस श्रेणी के लिए एमएचआरडी अधिसूचना अपनाने को रिपोर्ट करना। To report adoption of MHRD notification regarding introduction of EWS category in admissions.	95-98
78.24	नए पुरस्कारों और छात्रवृत्ति के प्रतिष्ठापन को रिपोर्ट करना। To report institution of new awards and scholarships.	99-100

Item No. 78.13: To consider the modification in the eligibility criteria and selection process for admission of a Project staff in Ph.D. programme.

IRC in its 28th meeting held on March 28, 2019 recommended the modified admission process for PhD admission of a project staff.

A project staff seeking admission in the Ph.D. programme can be admitted through any of the following procedures:

a. A department/center can select a candidate under project category during regular selection for Ph.D. programme.

b. A project staff appointed on a research position in an externally funded research project shall be allowed to register in Ph.D. programme if he/she fulfils the eligibility requirements of the Ph.D. program and is selected through the following selection committee of the Department/ Center in which the admission is sought:

(i) Nominee of Dean (SRIC) from the panel approved by the Director.
(ii) Head of the concerned Department/Center or his Nominee
(iii) Concerned Principal Investigator
(iv) One faculty member from outside the Department/Center as available to the PI
(v) Head's nominee (two DRC/CRC members)
(vi) One external expert from outside the Institute if required by the sponsor

All the other eligibility criteria/requirements remain the same as per Senate resolution 72.3.

The above is submitted for the consideration of the Senate.

Item No. 78.14: To consider the course credit requirements for candidacy in Ph.D. programme as directed by the 77th Senate.

The IRC in its 28th meeting held on March 28, 2019 deliberated on the proposal in detail and resolved as given in the Table below.

Table: Course credit requirement for candidacy in Ph.D. programme

S. No.	Qualification	Credit Requirements	Remarks
1	M.Tech, M.Arch./MURP, or equivalent	Minimum 12 credits of P.G. level theory courses	a. In addition to minimum credits requirements a student shall take one seminar of 2 credits. b. Student can also take one self-study theory course or an Online course of PG level.
2	M.Sc/M.A./M.B.A.or equivalent, admitted to Science/ HSS/ Management department	Minimum 15 credits out of which at least 12 credits shall be taken from P.G. level theory courses	
3	B.Tech. or equivalent, or M.Sc. or equivalent, admitted to any one of the engineering departments/centres	Minimum of 24credits of P.G. level theory courses	

The above is submitted for the consideration of the Senate.

Item No.78.15: To consider the Seat Matrix for UG and all Masters' Programmes including Ph.D. for the academic year 2019-20.

Vide item No. 69.2.8, IAPC recommended UG Seat Matrix **(Appendix 'A').**

Vide item No. 69.3.1, IAPC recommended M.Tech./ M.Arch./ MURP Seat Matrix **(Appendix 'B').**

Vide item No. 69.2.9, IAPC recommended M.Sc. Seat Matrix **(Appendix 'C').**

Vide item No. 69.2.10, IAPC recommended MBA Seat Matrix **(Appendix 'D').**

Vide item No. 29.2.1, emergent IRC recommended PMRF Seat Matrix in line with the NCC-PMRF **(Appendix 'E').**

The Chairman Senate approved the Ph. D. Seat Matrix for Autumn Semester 2019-20 on the recommendation of 27th IRC. The same is being reported to the Senate.**(Appendix 'F').**

S. No.	Program	Seat Capacity	Gender Neutral	Change in	Modified Seat capacity	Modified	Female excluding Supernumerary	% of EWS	Increase Seat	New Seat Capacity	New Gender Neutral	% Female of C19	Supernumerary	Final Female Only	Final Gender Neutral	Seat including Supernumerary	% of Female in 2019
		C18	GN18	seat capacity	2019	gender neutral	F18		I19	C19	GN19		SN19	F19			
1	Biotech	35	29	0	35	29	6	3	2.2	37.2	30.8	17.13	0	6.4	30.8	37.2	17.13
2	Chemical	90	78	0	90	78	12	3	5.7	95.7	82.7	13.55	4	17.0	82.7	99.7	17.02
3	Civil	135	128	0	135	128	7	3	8.5	143.5	135.1	5.89	20	28.4	135.1	163.5	17.40
4	Comp. Sc.	75	72	0	75	72	3	3	4.7	79.7	75.9	4.77	12	15.8	75.9	91.7	17.23
5	Electrical	120	108	0	120	108	12	3	7.6	127.6	114.3	10.42	11	24.3	114.3	138.6	17.53
6	Electronics	80	71	0	80	71	9	3	5.1	85.1	75.2	11.59	6	15.9	75.2	91.1	17.42
7	Engg. Physics	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
8	Mechanical	100	100	0	100	100	0	3	6.3	106.3	105.2	1.01	21	22.1	105.2	127.3	17.34
9	Metallurgical	80	73	0	80	73	7	3	5.1	85.1	77.2	9.24	8	15.9	77.2	93.1	17.04
10	Polymer	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
11	Production	40	38	0	40	38	2	3	2.5	42.5	40.1	5.71	6	8.4	40.1	48.5	17.37
12	Architecture	30	24	0	30	24	6	3	1.9	31.9	25.6	19.82	0	6.3	25.6	31.9	19.81
13	Geological	30	24	0	30	24	6	3	1.9	31.9	25.6	19.82	0	6.3	25.6	31.9	19.82
14	Geophysical	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
15	Mathematics	30	28	0	30	28	2	3	1.9	31.9	29.6	7.28	4	6.3	29.6	35.9	17.61
16	Chemistry	20	16	0	20	16	4	2	1.3	21.3	17.0	19.82	0	4.2	17.0	21.3	19.82
17	Physics	20	17	0	20	17	3	3	1.3	21.3	18.0	15.12	1	4.2	18.0	22.3	18.83
	Total	975	884		975	884	91		61.6	1036.6	935.1		99	200.5	935.1	1135.6	

	Please Enter the values in Green Columns (B, C, D, E and I) only	
C18	Seat Capacity 2018 as given in JOSAA website	
GN18	Gender Neutral 2018 as given in JOSAA website	
% of EWS	Percentage of EWS for 2019	

For new programs C and D columns will be zero

For new programes eneter the seat capacity in E

For change in seat capacity enter the difference from last capacity in E

Appendix 'B'
Item No. Senate/78.15

Proposed Seat for M.Tech./M.Arch./MURP Admission 2019-20

S.No	Academic Department/ Centre & (Code)	Academic Programmes		Main Gate Discipline(s)					Other GATE Disciplines					EWS*	Total Seats in Dept/ Centre
		Name	Code	GATE Discipline Code	GEN	OBC	SC	ST	GATE Discipline Code	GEN	OBC	SC	ST		
1	Architecture and Planning (ARD)	M.Arch	10	AR(12)	8	3	2	1	-	-	-	-	-	1	25
		M U R P	11	AR(10)	5	2	2	1	CE(2)	1	1	0	0		
2	Alternate Hydro Energy Centre (AHC)	M.Tech. Alternate Hydro Energy Systems	12	CE(2)	1	1	0	0	AG/CH/EE/EC/ME/ PI/XE (13)	7	3	2	1	1	27
		M.Tech. Environmental Management of Rivers and Lakes	13	CE(3)	1	1	1	0	AG/CH/EE/ME/PI/X E/AR/CY/BT/PH/MA /XL/EY(8)	4	2	1	1		
3	Chemical Engineering (CHD)	M.Tech. Chemical Engineering	14	CH(20)	9	6	3	2	-	-	-	-	-	1	21
4	Civil Engineering (CED)	M.Tech. Environmental Engg.	16	CE(11)	5	3	2	1	CH(2)	1	1	0	0	3	91
		M.Tech. Geomatics Engg.	17	CE(7)	3	2	1	1	AR/CS/EC/EE /AG/MN(7)	4	2	1	0		
		M.Tech. Geotechnical Engg.	18	CE(13)	7	3	2	1	MN (2)	1	1	-	-		
		M.Tech. Hydraulic Engg.	19	CE(11)	5	3	2	1	-	-	-	-	-		
		M.Tech. Structural Engg.	20	CE(21)	9	6	4	2	-	-	-	-	-		
		M.Tech. Transportation Engg.	21	CE(14)	7	4	2	1	-	-	-	-	-		
5	Earthquake Engineering (EQD)	M.Tech. Soil Dynamics	22	CE(12)	6	3	2	1	-	-	-	-	-	1	41
		M.Tech. Structural Dynamics	23	CE(18)	9	5	3	1	-	-	-	-	-		
		M.Tech. Seismic Vulnerability and Risk Assessment	24	CE(10)	5	3	1	1	-	-	-	-	-		
6	Electrical Engineering (EED)	M.Tech. Electric Drives & Power Electronics	25	EE(15)	8	4	2	1	-	-	-	-	-	2	62
		M.Tech. Instrumentation and Signal Processing	26	EE(10)	5	3	1	1	EC/IN(5)	3	1	1	0		
		M.Tech. Power System Engg.	27	EE(15)	7	5	2	1	-	-	-	-	-		
		M.Tech. Systems and Control	28	EE(11)	5	3	2	1	EC/IN(4)	1	1	1	1		
7	Electronics and Communication Engineering (ECD)	M.Tech. Communication Systems	29	EC(12)	6	3	2	1	-	-	-	-	-	1	34
		M.Tech. R.F. & Microwave Engg.	30	EC(10)	5	3	1	1	-	-	-	-	-		
		M.Tech. Microelectronics and VLSI	31	EC/PH(11)	5	3	2	1	-	-	-	-	-		
8	Computer Science and Engineering (CSD)	M.Tech. Computer Science & Engg.	32	CS(31)	15	9	5	2	-	-	-	-	-	1	32
9	Hydrology (HYD)	M.Tech. Hydrology	33	CE/AG(18)	9	5	3	1	GG/XE/PH/ EY(3)	1	1	0	1	1	22
10	Mechanical and Industrial Engineering (MED)	M.Tech. CAD, CAM & Robotics	34	ME/PI(12)	6	4	1	1	-	-	-	-	-	2	60
		M.Tech. Machine Design Engg.	35	ME/PI(12)	6	3	2	1	-	-	-	-	-		
		M.Tech. Production & Industrial Systems Engg.	36	ME/PI(12)	6	3	2	1	-	-	-	-	-		
		M.Tech. Thermal Engg.	37	ME/PI(11)	5	3	2	1	-	-	-	-	-		
		M.Tech. Welding Engg.	38	ME/PI(11)	5	3	2	1	-	-	-	-	-		
11	Metallurgical and Materials Engineering (MTD)	M.Tech. Industrial Metallurgy	39	MT(3)	2	1	0	0	ME/PI/XE (8)	4	2	1	1	1	23
		M.Tech. Materials Engg.	40	MT(4)	2	1	1	0	PH/ME/PI/CY/XE (7)	3	2	1	1		
12	Paper Technology Saharanpur Campus (PPD)	M.Tech. Pulp & Paper	41	CH(8)	4	2	1	1	ME/BT/TF/EY (4)	2	1	1	0	1	26
		M.Tech Packaging Technology	42	CH(7)	3	2	1	1	BT/CY/ME/TF (6)	3	2	1	0		
13	Water Resources Development and Management (WRD)	M.Tech. Irrigation Water Management	43	CE/AG(8)	4	2	1	1	-	-	-	-	-	1	21
		M.Tech. Water Resources Development	44	CE/EE/ME (12)	5	4	2	1	-	-	-	-	-		
15	Physics (PHD)	M.Tech. Solid State Electronic Materials	46	PH(7)	3	2	1	1	EE/EC/MT (3)	2	1	0	0	1	21
		M.Tech. Photonics	47	PH(7)	3	2	1	1	EE/EC/MT/IN (3)	1	1	1	0		
16	Nanotechnology (NTC)	M.Tech. Nanotechnology	48	MT/ME/EC/CH/BT/ CE (4)	2	1	1	0	CY/PH/XL (6)	2	2	1	1	1	11
17	Disaster Mitigation and Management (DMC)	M.Tech Disaster Mitigation and Management	49	CE(5)	2	1	1	1	ME/PI/CS/CH/AR/G G/PH/MA/XL/XE/EY /BT (5)	2	2	1	0	1	11
18	Transportation Systems (TSC)	M.Tech Infrastructure Systems	50	CE(3)	1	1	1	0	ME/PI/CH/EE/EC/C S/ AR (7)	3	2	1	1	1	11
19	Biotechnology (BTD)	M.Tech. Bioprocess Engineering	51	CH (5)	2	1	1	0	BT/AG/XE/TF (5)	2	2	1	1	1	11
		Total			204	119	68	36		47	30	15	9	22	550

* EWS seats will be allotted to the candidates with any eligible GATE discipline in the department/programme as per merit.

Appendix 'C'
Item No. Senate/78.15

Intake for M.Sc. for 2019-20

S.No.	DEPTT	CODE	PROGRAMME	TOTAL	GEN	OBC	SC	ST	PD 5% Horizontal
1	Earth Science **(ES)**	1801	M.Sc. (Applied Geology)	15	8	4	2	1	0
2	Biotechnology **(BT)**	1802	M.Sc. (Biotechnology)	37	18	10	6	3	G-1, B-1, T-1
3	Chemistry **(CY)**	1803	M.Sc. (Chemistry)	45	23	12	7	3	G-1, B-1, C-1
4	Mathematics **(MA)**	1804	M.Sc. (Mathematics)	30	15	8	5	2	G-1
5	Physics **(PH)**	1805	M.Sc. (Physics)	25	12	7	4	2	G-1
6	Humanities & Social Sciences **(HS)**	1806	M.Sc. (Economics)	30	15	8	5	2	G-1
			Total	182	91	49	29	13	9

Seat Matrix for MBA programme 2019-20

Programme	Intake	GEN	OBC	SC	ST	PD
MBA	95	48	26	14	7	5% Horizontal

Appendix 'E'
Item No. Senate/78.15

Proposed seat matrix for admission to Ph.D. Programme under PMRF (July 2019)

Name of the Department	PMRF Discipline	Intake
	Agriculture and Food Engineering	
Architecture and Planning	Architecture and Regional Planning	4
Biotechnology	Biological Sciences	5
	Biomedical Engineering	
Chemical Engineering	Chemical Engineering	2
Chemistry	Chemistry	4
Civil Engineering	Civil Engineering	8
Computer Science	Computer Science	2
• Electrical Engineering • Electronics & Communication Engineering	Electrical Engineering (including ECD)	7
	Engineering Design	
• Hydro and Renewable Energy • Applied Science and Engineering • Center for Transportation Systems • Centre for Disaster Mitigation & Management • Centre for Nanotechnology • Earth Sciences • Earthquake Engineering • Electronics and Communication Engineering • Hydrology • Paper Technology • Polymer and Process Engineering • Water Resources Development and Management	Interdisciplinary Programs in Science and Engineering (AHC, ASE, TSC,DMC, NTC, ESD, EQD, HYD, PPD, PPE, WRD)	15
Metallurgical and Materials Engineering	Material Science and Metallurgical Engineering	4
Mathematics	Mathematics	3
Mechanical & Industrial Engineering	Mechanical	6
	Mining, Mineral, coal and Energy sector	
	Ocean Engineering and Naval Architecture	
Physics	Physics	4
	Textile Technology	
	TOTAL	**64**

Appendix 'F'
Item No. Senate/78.15

Category wise vacancy i.e. 27% for OBC, 15% for SC, 7.5% for ST and 3% for EWS category for admission to Ph.D program for Autumn Semester of the session 2019-20 under Institute Assistantship

Deptt/ centre	Faculty Position (01.01.19)	Total seats @4.0 x no. of faculty	Increased with 6.37%	Category wise Total Seats					Seats Filled					Vacancy					
				Gen	Gen-EWS	OBC	SC	ST	Gen	OBC	SC	ST	Total filled	Total vacancy	Gen	EWS* 3%	OBC	SC	ST
(Roorkee Campus)																			
AHEC	5	20	21	10	1	6	3	1	6	7	3	1	17	4	3	1	0	0	0
Arch & Plng	18	72	77	36	2	21	12	6	28	14	10	0	52	25	8	2	7	2	6
Biotechnology	26	104	111	53	3	30	17	8	46	15	4	1	66	45	7	3	15	13	7
C-Trans	4	16	17	8	1	5	2	1	10	3	2	1	16	4	1	1	2	0	0
Dis. Mit. &Magnt	4	16	17	8	1	5	2	1	6	4	1	1	12	5	2	1	1	1	0
Nanotechnology	4	16	17	8	1	5	2	1	7	4	1	0	12	5	1	1	1	1	1
Chemical Engg	19	76	81	39	2	22	12	6	23	23	12	1	59	22	15	2	0	0	5
Chemistry	24	96	102	48	3	28	15	8	32	11	9	0	52	50	16	3	17	6	8
Civil Engg	43	172	183	87	5	49	28	14	75	44	22	5	146	37	12	5	5	6	9
Computer Sc. & Engg	12	48	51	24	2	14	7	4	15	5	4	0	24	27	9	2	9	3	4
Earth Sciences	22	88	94	45	3	25	14	7	34	9	3	1	47	47	11	3	16	11	6
Earthquake Engg	12	48	51	24	2	14	7	4	19	8	1	2	30	21	5	2	6	6	2
Electrical Engg	30	120	128	61	4	34	19	10	49	22	7	0	78	50	12	4	12	12	10
E&CE	22	88	94	45	3	25	14	7	24	14	3	0	41	53	21	3	11	11	7
Hum &Soc. Sciences	15	60	64	30	2	17	10	5	20	16	7	1	44	20	10	2	1	3	4
Hydrology	8	32	34	16	1	9	5	3	12	2	1	1	16	18	4	1	7	4	2
Inst. Instr. Centre	1	4	4	2	0	1	1	0	0	1	0	0	1	3	2	0	0	1	0
Management Studies	14	56	60	28	2	16	9	5	27	9	7	0	43	17	1	2	7	2	5
Mathematics	26	104	111	53	3	30	17	8	21	21	9	0	51	60	32	3	9	8	8
Mech&Indl Engg	42	168	179	85	5	48	27	14	61	37	25	5	128	51	24	5	11	2	9
Met & Mat Engg	21	84	89	42	3	24	13	7	26	20	12	1	59	30	16	3	4	1	6
Physics	36	144	153	73	5	41	23	11	44	22	5	1	72	81	29	5	19	18	10
WRD & M	5	20	21	10	1	6	3	1	8	3	2	0	13	8	2	1	3	1	1
Total	**413**	**1652**	**1759**	**835**	**55**	**475**	**262**	**132**	**593**	**314**	**150**	**22**	**1079**	**683**	**243**	**55**	**163**	**112**	**110**
(Saharanpur Campus)	Total Seat @ 8 x no. of faculty																		
Applied Sc. & Engg	4	32	34	16	1	9	5	3	14	7	1	0	22	11	2	1	2	4	2
Paper Technology	5	40	43	20	1	12	7	3	17	5	5	0	27	14	3	1	6	1	3
Polymer & Process Engg	12	96	102	49	3	27	15	8	32	14	11	0	57	42	17	3	12	3	7
Total	**21**	**168**	**179**	**85**	**5**	**48**	**27**	**14**	**63**	**26**	**17**	**0**	**106**	**67**	**22**	**5**	**20**	**8**	**12**

* Note: if the cut-off for GEN is X, it should not go below 0.9X for OBC/EWS and 0.67X for SC/ST/PD based on IRCresolution No. 28.2.13

Item No. 78.16: To consider the proposal of Department of Civil Engineering regarding modification in the structure of M. Tech. (Transportation).

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal and recommended it with modifications **(Appendix 'A').**

The modified structure and syllabi is submitted for the consideration of the Senate.

DEPARTMENT OF CIVIL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program code: 21 M. Tech. (Transportation Engineering)
Department: CE Civil Engineering
Year: I

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester – I (Autumn)														
1	CEN-561	Traffic Analysis and Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-562	Pavement Analysis and Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
3	CEN-563	Urban Mass Transit Systems	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4	CEN-564	Geometric Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
5	-	Program Elective – I	PEC	3/4	3	1	-	3	-	20-35	-	20-30	40-50	-
		Total		19/20										
Semester – II (Spring)														
1	CEN-664	Transportation Planning	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-700	Seminar	SEM	2	0	0	2		-	-	-	-	100	-
3		Program Elective – II	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4		Program Elective – III	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
5		Program Elective - IV	PEC	3/4	3	1	-	3	-	20-35	-	20-30	40-50	-
6		Program Elective - V	PEC	2	-	-	~~3~~ 4	-	3	-	50	-	-	50
		Total		19/20										

DEPARTMENT OF CIVIL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program code: 21 M. Tech. (Transportation Engineering)
Department: CE Civil Engineering
Year: II

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester – I (Autumn)														
1	CEN-701A	Dissertation Stage-I (to be continued in Spring semester)	DIS	12	-	-	-	-	-	-	-	-	100	-
		Total		12										
Note: Student can take 1 or 2 audit courses as advised by the supervisor, if required														
Semester – II (Spring)														
1	CEN-701B	Dissertation Stage-II (to be continued in Spring semester)	DIS	18	-	-	-	-	-	-	-	-	100	-
		Total		18										

Summary				
Semester	1	2	3	4
Semester wise total credits	19/20	19/20	12	18
Total credits	68/70			

Programme Elective Courses (Transportation Engineering)

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Courses Against Autumn Semester Electives														
1	BM-513	Business Statistics	PEC	3	3	-	-	3	-	25	-	25	50	-
2	CEN-501	Environmental Modelling and Simulation	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
3	CEN-513	Remote Sensing and Digital Image Processing	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
4	CEN-521	Advanced Numerical Analysis	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
5	CEN-522	Advanced Soil Mechanics	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
6	CEN-543	Advanced Concrete Design	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
7	CEN-545	Finite Element Analysis	PEC	4	3	-	2	3	-	10-25	25	15-25	30-40	-
8	CEN-565	Planning, Design and Construction of Rural Roads	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
9	CEN-566	Airport Planning and Design	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
10	CEN-567	Transportation Systems Analysis	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
11	CEN-568	Advanced Highway Material Characterisation	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
12	CTN-501	Quantitative Techniques for Infrastructure Systems	PEC	4	3	-	2	3	-	15	25	20	40	-

Courses Against Spring Semester Electives														
1	CEN-604	Environmental Impact and Risk Assessment	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-614	Theory and Application of GIS	PEC	4	3	-	2	3	-	10-25	25	15-25	30-40	-
3	CEN-621	Advanced Geotechnical Exploration and Testing	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4	CEN-661	Advanced Highway Construction and Maintenance	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
5	CEN-662	Intersection Design and Analysis	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
6	CEN-663	Pavement Evaluation and Management	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
7	CEN-665	Road Traffic Safety	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
8	CEN-666	Transport Economics	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
9	CEN-667	Transportation Studies and Analysis Lab	PEC	2	-	-	3	-	~~3~~ 4	-	50	-	-	50
10	CEN-668	Multi-Agent Transport Simulation Framework	PEC	2	-	-	3	-	~~3~~ 4	-	50	-	-	50

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **CIVIL ENGINEERING**

1. Subject code: **CEN-561** Course Title: **Traffic Analysis and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester: **Autumn**
7. Subject Area: **PCC** 8. Pre-requisite: **Nil**
9. **Objective:** To introduce the advances in traffic engineering analysis and design and to make the students conversant with relevant field applications.

10. Details of Course:

S. No.	Particulars	Contact Hours
1	Introduction: Elements of traffic engineering, issues for traffic engineers; road users, vehicles, highways and control devices.	04
2.	Traffic Stream Characteristics: Traffic stream parameters, Time Space diagram, relationship among q,k,u, Macroscopic Fundamental Diagrams (MFD).	04
3.	Traffic Studies: Traffic volume studies, speed, travel time and delay studies, parking studies, RSI Survey, WTP Survey, accident data collection, pedestrian studies.	04
4.	Traffic design: Capacity analysis concepts – urban streets and rural highways, design of parking facilities, street design.	06
5.	Statistical application in Traffic Engineering: Overview of Probability Functions and Statistics, Normal Distribution and application, Confidence Bounds, Sample Size, Binomial Distribution, Poisson Distribution, Hypothesis Testing.	08
6.	Microscopic Modeling: Classification of Time Headway, Random Headway State, Constant Headway State, Intermediate Headway State, Car Following Theory.	06
7.	Time Series Analysis: Basic Components of Time Series, Smoothening and Decomposition Methods, Data Filters, Auto Correlations and Moving Averages.	04
8.	Management Techniques: Traffic calming; Congestion and road user pricing; priority movements; traffic regulations and control systems; use of intelligent systems.	06
	TOTAL	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	William R. Mcshane and Roger P. Roess, "Traffic Engineering", Pearson (4^{th} Edition).	2013
2.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2012
3.	C A O'Flaherty, Ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA	2006
4.	May, A.D., "Fundamentals of Traffic Flow", Prentice Hall, Inc. 2^{nd} Ed.	1990
5.	Carlos F. Daganzo. "Fundamentals of Transportation and Traffic Operations", Pergamon	1997
6.	Simon P. Washington, Matthew G. Karlaftis and Fred L. Mannering, "Statistical and Econometric Methods for Transportation Data Analysis", Second Edition, CRC Press	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Civil Engineering Department**

1. Subject Code:**CEN-562** Course Title: **Pavement Analysis and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge to students related to analysis and design with respect to Highway Pavement.
10. Details of Course:

S. No.	Particulars	Contact Hours
1.	**Introduction:** Components of pavement structure, importance of subgrade soil properties on pavement performance. Functions of subgrade, subbase, base course and wearing course.	4
2.	**Stresses in Pavements:** Flexible pavements - Stresses in homogeneous masses and layered systems, deflections, shear failures, equivalent wheel and axle loads; Rigid pavements - Westergaard's and Thomlinson's analysis of warping stresses, Combination of stresses due to different causes, Effect of temperature variation on Rigid Pavements	8
3.	**Design Elements of Flexible Pavements:** Loading characteristics-static, impact and repeated loads, effects of dual wheels and tandem axles, area of contact and tyre pressure, modulus or CBR value of different layers, equivalent single wheel load, equivalent stress and equivalent deflection criterion, equivalent wheel load factors, climatic and environmental factors.	6
4.	**Design Methods for Flexible Pavements:** California bearing ratio (CBR) adopted in various countries, IRC: 37-2018, AASHTO Design Guide, Triaxial method, Boussinesq's and Burmister's analysis, Pavement designing software (IITPAVE, KENPAVE, MICH-PAVE); Design of flexible pavements for low volume roads.	8
5.	**Rigid Pavements:** Design of rigid pavement using IRC: 58-2015 and AASHTO guidelines, Wheel load stresses, Role of modulus of subgrade reaction, Westergaard's analysis, Bradbury's approach Arlington test, Pickett's corner load theory and charts for liquid, elastic and soil of finite and infinite depths of subgrade.	8
6.	**Types of Concrete Pavements:** Roller Compacted Concrete Pavement, Plain Jointed Concrete Pavement, Continuously Reinforced Concrete Pavement, Prestressed concrete pavement, Design of Tie Bars and Dowel Bars, Role of Dry Lean Concrete; Rigid pavement design for low volume roads	8
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Yoder, E.J. and Witczak, M.W., "Principles of Pavement Design 2nd Ed", John Wiley & Songs, Inc.	1975
2	O'Flaherty, A. Coleman, "Highways : the Location, Design, Construction and Maintenance of Road Pavements", 4th Ed., Elsevier	2006
3	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press Taylor &Francies Group.	2006
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering Nem Chand Jain & Bros, 8th Ed.	2005
5	Papagiannakis, A.T. and Masad, E.A., "Pavement Design and Materials, John Wiley & Sons Inc.	2008
6	Yang H. Huang, " Pavement Analysis and Design" Second Edition, Pearson Education Inc.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Civil Engineering**

1. Subject Code: **CEN-563** Course Title: **Urban Mass Transit Systems**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PCC**
9. Objective of Course: To introduce the students to urban mass transit systems, their types, suitability, planning, operation and management aspects.
10. Details of the Course.

S. No.	Course Description	Contact hours
01	**Introduction**: Mass transit systems, Elements / components of transit systems; Urban Mass Transit systems, types, characteristics, suitability and adaptability of these systems; Evolution of urban transportation.	3
02	**Transit System Planning**: Planning needs; Short-range and long-range planning; Planning procedures and methodology, Data collection; Medium performance transit systems and high-performance transit systems; trends in transit planning.	6
03	**Transit Demand Estimation and Evaluation:** Transit demand forecasting; transit mode evaluation; comparison and selection of most suitable transit mode.	8
04	**Transit System Operations:** Basic operational elements; transit travel characteristics; transit scheduling; transit line analysis – planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity.	10
05	**Transit Networks and System Analysis:** Transit networks – types and their characteristics; transfers in transit networks; system analysis in transit – conceptual models, modeling procedures; terminal or station location planning – issues, objectives, station spacing decisions.	8
06	**Economics and Financing of Transit Systems:** Transit system performance and economic measures; transit fares – structure, collection and levels; financing of transit services; public and private integration of transit services.	6
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Vukan R. Vuchic, "Urban Transit – Operations, Planning and Economics", John Willey and Sons, Inc., USA	2004
2	Vukan R. Vuchic, "Urban transit systems and technologies", John Willey and Sons, Inc., USA	2007
3	C A O'Flaherty, 'Transport Planning and Traffic Engineering', Butterworth-Heinemann, Burlington	2006
4	C JotinKhisty and B Kent Lall, "Transportation Engineering" Prentice-Hall of India Pvt Ltd., New Delhi	2003

NAMEOFDEPTT/CENTRE: **Department of Civil Engineering**

1. Subject Code:**CEN-564** Course Title : **Geometric Design**
2. Contact Hours : **L: 3 T : 1 P: 0**
3. Examination Duration(Hrs): **Theory 3 Practical 0**
4. Relative Weight : **CWS: 20-35 PRS: 0 MTE: 20-30 ETE: 40-50 PRE: 0**
5. Credits: **4** 6.Semester: **Autumn** 7. Subject Area :**PCC**
8. Pre-requisite: **Nil**
9. Objective: To introduce concepts and design procedures for different types of roads and associated facilities.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Design Controls - Topography and physical features, traffic, vehicular characteristics, speed and safety; Space standards for urban, rural and hill roads, Sight distance requirements, Access controls	6
2.	**Cross-section Elements :** Single lane, Two lane, Multi-lane highways, Expressways, Urban roads; Street design concepts, bicycle tracks, pedestrian facilities, street furniture, Design of Speed Breaker	6
3.	**Alignment :** Horizontal Alignment - Curve design, Super-elevation design, Transition curve design, Attainment of super-elevation, Pavement widening, Sight distance on horizontal curves; Vertical Alignment - Gradients, Grade compensation, Design of vertical curves, Combination of horizontal and vertical alignment, vertical clearance for underpasses and elevated structures	6
4.	**Highway Capacity:** Two lane, Four lane, Six lane non-urban highways, Urban roads, Expressways, HCM USA and IRC Specifications	8
5.	**Intersection Geometry:** Visibility requirements, Principles of channelization, Layout design for types of intersections, on-ramps and off-ramps (flyovers and Access controlled facilities), Acceleration and deceleration lanes, Two-way turn lanes,	6
6.	**Design of Facilities:** Design of on-street and off-street parking facilities, multi-storyed Parking; Design of bus shelters and bus lay-bye, Bus terminal, Truck terminals and truck lay-bye, Container terminal, Toll Plaza, Foot-over bridge and sky-walk	10
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Wright, P.H. & Dixon, K.K., "Highway Engineering", 7th Ed., John Wiley & Sons.	2004
2.	Transportation Research Board (TRB), Highways Capacity Manual, National Research Council, Washington D.C.	2010
3.	Khisty, C.J. and Lal, B.K., "Transportation Engineering - An Introduction", Prentice Hall of India Pvt. Ltd.	2006
4.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2008

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN- 565** Course Title: **Planning, Design and Construction of Rural Roads**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the concepts of Planning, Geometric Design, Pavement Design, Construction and Maintenance of Rural Roads
10. Details of the Course:

S. No.	Course Description	Contact hours
01	**Planning of Rural Roads**: Classification of Roads, Brief introduction to earlier 20 year Plans, System's Approach, NATPAC Model, Gravity Model, CRRI Model, FBRNP Model, Concepts of PMGSY	08
02	**Geometric Design**: Geometric Design Standards for Rural Roads with special reference to PMGSY, Hill Road Standards.	04
03	**Pavement Design:** Various pavement design methods for Rural roads including Flexible and Rigid pavements using IRC:SP-20, IRC-72, IRC-37, IRC:SP-62, CRRI Nomograms	04
04	**Mix Design Methods:** CRRI Method, Triangular Chart Method, Fuller's Method, Rothfuch method, PI based Method	06
05	**Materials:** Brief introduction to conventional materials, Marginal and Waste Materials including Fly Ash, GBFS, BFS, SMS, Bagasse, CRMB, etc	06
06	**Construction:** Case Studies of Waste Material Utilization in Rural Roads, Low Cost Techniques for Rural Road Construction, Tractor Bound Technology, Special Considerations for Hill Areas	06
07	**Drainage:** Transverse and Longitudinal Drainage, Design of drains, Minor CD Works, Filter Design etc.	04
08	**Maintenance:** Type and Causes of Failures, Remedies	04
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Rural Roads Manual , SP-20, IRC	2002
2	Document on Rural Road Development, Vol I & II, CRRI	1990
3	PMGSY Operation Manual, NRRDA, Govt of India	2005
4	Specifications for Rural Roads, MoRD, IRC	2004
5	Khanna S.K., Justo C.E.G,, Highway Engineering, Nem Chand & Bros, Roorkee	2004
7	Quality Assurance Handbook for Rural Roads, NRRDA, Govt. of India	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-566** Course Title: **Airport Planning and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To familiarize students on various techniques related to airport planning and design.
10. Details of the Course.

S. No.	Course Description	Contact hours
01	**Airport Planning:** Airport master plan, aircraft characteristics related to airport planning and site selection, air traffic demand analysis, planning surveys, airport zoning.	08
02	**Geometric Design:** Airport classification, runway and taxiway geometric standards, exit taxiways, separation and clearances.	06
03	**Terminal Areas:** Facilities, space requirement, number and size of gate positions, aircraft parking system.	06
04	**Visual Aids :** Airport day time markings, airport lighting, visibility, visual aids	03
05	**Structural design of airport pavements:** Design Factors, Design of flexible and rigid pavements	06
06	**Airside capacity and delay:** Mathematical models for capacity and delay, space time concept, models for mixed traffic	06
07	**Air Traffic Control:** Importance of flight rules, navigational aids, air traffic controls, obstruction and clearance requirements	04
08	**Airport Drainage :** Design run-off, inlet size and location design, surface and subsurface design	03
	Total	**42**

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	Robert Horonjeff and Francis X. McKelvey, "Planning & Design of airports, McGraw Hill, Inc, 4th edition	1993
2	S. K. Khanna, M. G. Arora and S. S. Jain, "Airport Planning & Design", Nem Chand and Bros, Roorkee	2000
3	Ashford, N. and Wright, P. H., "Airport Engineering, Wiley, 3rd edition.	1992
4	ICAO, "Aerodrome design manual", International Civil Aviation Organization, Montreal, Canada	1983

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Civil Engineering**

1. Subject Code: **CEN- 567** Course Title: **Transportation Systems Analysis**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the students to the analysis of different transportation systems, their components, operations, systems analysis approaches and economics.
10. Details of the Course:

S. No.	Course Description	Contact hours
01	**Introduction**: Scope of transportation and impact on society; System planning process and problem solving process; transportation problems.	06
02	**Transportation Technologies**: Transportation technologies, suitability and adaptability; Transportation system components; Transportation system characteristics – technological and operational; Path – vehicle interaction; Volume – Density relationship for containers.	10
03	**Analysis of Systems:** Generation of alternatives; Performance evaluation of system and performance functions; Operational planning and analysis of components; Transportation network analysis and Minimum path algorithms; Travel in space and time; Planning for non-motorized transportation; Freight transportation planning–models and methods; Residential location choice models, Car-ownership models; transportation software.	12
04	**Transportation Economics:** Transportation demand and supply; Equilibrium between supply and demand, transportation system equilibrium; Elasticity – direct and cross; concept of consumer surplus; transport demand models – sketch planning, incremental demand model, model estimation from traffic counts; transportation cost, travel – market equilibrium.	08
05	**Sustainable Transportation Planning:** Sustainable transportation – issues and principles; non-motorized transportation planning; Impact evaluation and impact models.	06
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Marvin L Manheim, "Fundamentals of Transportation Systems Analysis", The MIT Press, Cambridge, Massachusetts	1980
2	AdibKanafani, "Transportation Demand Analysis", McGraw Hill Inc, New York, U.S.A.	1983
3	Steenbrink, P.A., Optimization of Transport Network, John Wiley & Sons, NY.	1974
4	Konstadinos G Goulias, "Transportation System Planning – Methods and Applications", CRC Press, London	2002
5	C JotinKhisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi	2003
6	Thomas A Domencich and Daniel McFadden, "Urban Travel Demand – A Behavioural Analysis", North-Holland Publishing Company, Amsterdam	1975

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-568** Course Title: **Advanced Highway Material Characterisation**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weight **CWS 15-30** **PRS 20** **MTE 15-25** **ETE 30-40** **PRE 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the advanced technologies in pavement engineering materials and to make the students conversant with characterization of various conventional and alternative road construction materials.
10. Details of the Course.

S. No.	Course Description	Contact hours
1	**Soil:** Classification of soil, Identification and strength tests- Atterberg limits, compaction tests, California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS), Modulus of subgrade reaction, Resilient Modulus, Permeability, Free Swelling Index (FSI), Deleterious materials, sand equivalent test, Soil stabilization techniques.	06
2	**Aggregates:** Origin and Classification, physical, mechanical and durability properties, sampling techniques, aggregate texture and skid resistance, Polish Stone Value, Alkali-aggregate reactivity.	06
3	**Binders:** (i) **Bitumen**: Bitumen sources and manufacturing, Bitumen constituents and its properties, Structure and Rheology, tests on bitumen-emulsions & cutback, modified bitumen and its types, goals of modification, properties of modified bitumen, separation test, long-term and shorter aging of bitumen, Elastic recovery test of modified bitumen (ii) **Cement**: Origin, composition, Types of cement, physical properties of cement (consistency, setting times, soundness and strength of cement), flow test.	10
4	**Bituminous and Concrete Mix Designs:** Design of Granular Sub-base and their desirable properties; Design of Wet Mix Macadam and their desirable properties; Design of Bituminous Mixtures & reports- Desirable properties of mixes, Moisture susceptibility, stripping value, Fillers, Theory of fillers and specifications; Marshall Method MS-2; Foamed Asphalt Mix Design; Cold Mix Design. Concrete Mix Design - Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes, porosity of concrete; Dry Lean Concrete; Pavement Quality Concrete (PQC)	12
5	**Alternative Pavement Materials:** Recycled Concrete aggregates, Reclaimed asphalt pavement materials, use of industrial and agricultural wastes for pavement construction, chemical and mineral admixtures	08
	Total	**42**

LABORATORY TESTS

S. No.	Course Description
1	**Soil and Aggregate testing:** Free Swelling Index (FSI) and Deleterious material content, CBR test, Unconfined Compression test, Sand equivalent test, aggregate polishing and skid resistance test, soundness test.
2	**Straight-run bitumen/Modified bitumen Tests:** Penetration value test, Elastic recovery test of binders & Dynamic Shear Rheometer (DSR)
3	Formulation of design mixes for sub-base and unbound base course (Granular Sub-base & Wet mix Macadam)

4	**Bituminous Mixture:** Proportioning of aggregates, preparation of test specimens, and testing, formulations of bituminous mixtures (conventional bituminous mixtures for bound base courses
5	**Concrete mixes:** Proportioning of aggregates, preparation of test specimens, and testing, design of dry lean concrete mix, design of pavement quality concrete mix
6	**Alternative pavement materials:** Design of cement treated sub-base and base using reclaimed asphalt pavement materials.

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	P. Kumar Mehta, Paulo J.M. Monteiro, "Concrete microstructure, properties, and materials, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.	2006
2	Dr. L.R. Kadyali and Dr. N.B. Lala, "Pricnciples and Practices of Highway Engineering", Khanna Publishers, New Delhi.	2010
3	Paul H. Wright and Karen K. Dixon, " Highway Engineering" Seventh EditionJohn Wiley & Sons, Inc.	2004
4	Yang H. Huang, "Pavement Analysis and Design", Second Edition, Pearson Prentice Hall.	2004
5	T.F. Fwa, "The Handbook of Highway Engineering", CRC, Taylor & Francis Group.	2006
6	S.K. Khanna, C.E.G. Justo and A.Veeragavan, "Highway Engineering" Revised 10th Edition, Nem Chand & Bros., Roorkee.	2015
7	Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-661** Course Title: **Advanced Highway Construction and Maintenance**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weight **CWS 15-30 PRS 20 MTE 15-25 ETE 30-40 PRE 0**
5. Credits: **4** 6. Semester **Spring**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the advances in highway construction and evaluation, making the students conversant with the different construction and evaluation techniques.
10. Details of the Course.

S. No.	Course Description	Contact hours
1	**Embankment & Subgrade** Setting Out. Clearing and Grubbing, Road formation width, Borrow Pits, Quarries, Construction under special cases, Embankment Construction, Subgrade construction, Backfilling, Preparation of cut formation, Surface and subsurface drains.	06
2	**Flexible Pavements** ***Subbase:*** Granular Subbase (GSB): ***Unbound Courses:*** Water Bound Macadam (WBM), Wet Mix Macadam (WMM); ***Bound Courses:*** Bituminous Macadam (BM), Dense Bituminous Macadam (DBM); ***Wearing Courses:*** Bituminous Concrete (BC), Semi Dense Bituminous Concrete (SDBC).	06
3	**Cement Concrete Pavement** Dry Lean Concrete (DLC), Roller Compacted Concrete Pavement (RCCP), Pavement Quality Concrete (PQC), Continuously Reinforced Concrete Pavement (CRCP), Cement Concrete Pavement Construction Techniques: Manual, Automated (Fixed Form, Slip Form).	10
4	**Highway Maintenance & Evaluation:** Need of Highway maintenance, methods of maintenance for flexible and rigid pavement layers; Load man, Different Types of Falling Weight Deflectometers (FWD) for evaluation of rigid and flexible pavements, Distress Modes - Cracking, Ruttingetc. Factors influencing deflections, Back-calculation of Pavement Layer Moduli and detection of loss of bonding of cement concrete pavements using FWD data; Destructive Structural Evaluation; Different Methods of NDT(Working Principles): Benkelman Beam, Pavement Safety Evaluation: Skid Resistance, Purposes, functional Evaluation: Serviceability concepts, Distress types: Bituminous and Concrete pavements; Visual Rating; PSI; Methods of Measuring Roughness:	08
5	**Quality Control in Highway Construction:** Execution and quality control prior to construction, during construction and post construction: Standard deviation, mean, normal distribution, control chart – Quality audit of finished pavement – Performa of quality assurance records.	06
	Total	42

LABORATORY TESTS:

S. No.	Course Description
1	**Aggregate testing:** Aggregate polishing value and skid resistance test
2	**Straight-run bitumen/Modified bitumen Tests:** Emulsion and Cutback, PAV (Pressure ageing vessel) and RTFOT (Rolling thin film oven test) – video class & demonstration, bitumen viscosity test (Rotational viscometer) – video class & demonstration
3	**Bituminous Mixture:** Resilient modulus of bituminous mixture (video class & demonstration), foamed asphalt mixture, cold mixture), fatigue and rutting tests (video class and demonstration)

4	**Concrete mixes:** Abrasion resistance test on hardened concrete (video class & demonstration), Concrete permeability test, Mercury Intrusion Porosimetry (MIP) –video class & demonstration
5	**Highway Maintenance related experiments:** Benkelman Beam tests, Merlin Test, Falling Weight Deflectometer, Axle Load Survey, Roughness survey of roads using Roughometer

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	HouXiangshen, Ma Songlin, "Highway maintenance and management" China communication Press.	2016
2	Sanford Eleazer Thompson, "Concrete in Highway Construction- A text book for highway engineers and supervisors" Forgotten Books Publisher	2018
3	Dr. L.R. Kadiyali and Dr. N.B. Lala, " Principles and Practices of Highway Engineering", Khanna Publisher.	2005
4	Richard Robinson, Uno, Danielson, Martin Snaith, "Road Maintnenance Management" Concepts and Systems, Palgrave publisher	1998
5	KandhalPrithvi Singh, "Bituminous Road Construction in India", PHI Learning Private Limited, Delhi- 110092.	2016

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-662** Course Title: **Intersection Design and Analysis**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weightage **CWS 20-35** **PRS 0** **MTE 20-30** **ETE 40-50** **PRE 0**
5. Credits: **4** 6. Semester **Spring**
7. Prerequisite: NIL 8. Subject Area: **PEC**

9. Objective of Course: To discuss various methods of design and analysis of different types of road intersections and interchanges.
10. Details of Course

Sl No.	Topics to be covered	Contact hours
1	Types of intersections, Principles of design, types of maneuvers, relative speed, conflict points and area	6
2	Intersection geometrics and their influence on design/operation	3
3	Operational analysis of two-way and all-way stop controlled intersections and roundabouts by US and Indian methods, mini roundabouts	6
4	Analysis of signal controlled intersections by US, British and Swedish methods, delay and its evaluation	12
5	Types of signals, Design of signals by Indian, US and British methods, signal coordination	6
6	Grade separated intersections and interchanges	4
7	Weaving sections and their operational evaluation	3
8	Intersection signs, marking and lighting	2

Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication
1	Transportation Engineering & Planning, by C. S. Papacostas and P. D. Prevedouros, Prentice Hall of India Private Limited, New Delhi	2001
2	Principles of Highway Engineering and Traffic Analysis, by Fred L Mannering, Walter P. Kilareski and Scott S. Washburn, Wiley India Edition	2007
3	Transportation Engineering, by C. JotinKhistya and B. Kent Lall Prentice Hall of India Private Limited, New Delhi	2006
4	Transport Planning and Traffic Engineering, by C A O Flaherty, Hodder Headline Group, London	1997
5.	Highway Capacity Manual of US, by Transportation research Board, Washington DC	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Civil Engineering Department**

1. Subject Code: **CEN-663** Course Title: **Pavement Evaluation and Management**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory 3** **Practical 0**
4. Relative weightage **CWS 20-35** **PRS 0** **MTE 20-30** **ETE 40-50** **PRE 0**
5. Credits: **4** 6. Semester: **Spring** 7.Subject Area: **PEC**
8. Pre-requisite: Nil
9. Objective: To provide knowledge related to Evaluation and Management with respect to Road Development.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Pavement Evaluation:** General concept of pavement evaluation, Evaluation of pavement performance; Evaluation of pavement structural capacity; Evaluation of pavement distress - Structural and functional, serviceability, fatigue cracking, pavement deformation and low temperature shrinkage cracking; Evaluation of pavement safety – Skid resistance, measurement, variation with time, traffic and climate, control.	6
2.	**Pavement Performance Evaluation:** Factors affecting performance, relation between performance and distress; Visual ratings, PSI, Methods of measuring roughness, response and profile; IRI – Quarter Car Model, riding number; Pavement performance prediction models for flexible and rigid pavements.	6
3.	**Pavement Structural Evaluation:** Different methods of NDT - Benkelman Beam, Bump Integrator, Dynaflect, LaCroixDeflectometer, Road Ratar, Rolling Dynamic Deflectometer, Loadman, Falling weight deflectometers; Factors influencing deflection; Back calculation of Pavement Layer Moduli; Flexible overlays and determination of overlay thickness. Rigid overlays and determination of overlay thickness. Design of Overlay by Benkelman Beam and Falling Weight Deflectometer.	12
4.	**Design Alternatives – Analysis, Evaluation and Selection:** Framework for pavement design, design objectives and constraints, Basic structural response models, characterization of physical design inputs, Generating alternative pavement design strategies. Economic evaluation of alternative pavement design strategies, analysis of alternative design strategies. Predicting distress, predicting performance, selection of optimal design strategies.	6
5.	**Pavement Management System (PMS):** Components and related activities, steps in implementation of a PMS; Design, construction and maintenance; Rehabilitation and Feedback data system; Examples of Working Design and Management Systems; Evaluation of alternate strategies and decision making; Techniques, tools and use of expert system in PMS.	8
6.	**Pavement Maintenance Management:** Components and related activities, Budgeting, Maintenance strategies and prioritization, Pavement life cycle cost analysis – components and methods.	4
	Total	42

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Hass, R., Hudson, W.R. and Zaniewski, J. "Modern Pavement Management" Krieger.	1994
2	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press, Taylor &Francies Group.	2006
3	Shain, M.Y., "Pavement Management for Airports, Roads and Parking Lots", Kluwer Academic Publishers Group.	2004
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering" Nem Chand & Bros,	2005

	Roorkee (U.A.) 8th Ed.	
5	Hudson, W.R., Haas, R. and Uddin, W., "Infrastructure Management", McGraw Hill.	1997
6	Hass R. & Hudson, W.R., "Pavement Management System", Mc Graw Hill Company, Inc. New York	1978

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

1. Subject Code :**CEN-664** Course Title : **Transportation Planning**
2. Contact Hours : **L: 3** **T : 1** **P: 0**
3. Examination Duration(Hrs): **Theory 3** **Practical 0**
4. Relative Weight : **CWS: 20-35** **PRS: 0** **MTE:20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PCC**
8. Pre-requisite: **Nil**
9. Objective of Course: To introduce the concept of travel demand modeling using four-stage sequential transportation planning.

10. Details of the Course.

S. No.	Contents	Contact Hours
1	**Introduction to Transportation**: Fields of Transportation, Role in Society, System-Environment Ensemble, Transportation Problems	05
2	**Planning Process**: Hierarchical Structure; Characteristics and objectives of planning, Problem solving and its morphology, Planning methodologies; Overview of urban transportation planning; Urban structure interaction and concepts.	08
3	**Transportation Data:** Data needs and sources; Survey methodology, Quality v/s quantity, Errors, Data collection methods, Attitudinal surveys, Questionnaire design and standardization, Study area and analysis zones, Sample size, Sampling units,frames and techniques.	07
4	**Trips:** Aggregate and disaggregate analysis, Definitions, Types of trips, Factors affecting trip generation, Methods of trip generation, Methods of trip distribution – Growth Factor methods, Synthetic methods, merits and demerits.	08
5	**Modal Analysis and Assignment:** Mode choice sets, Modal split models – First and second generation, Stochastic models, Choice theories, Discrete choice analysis, Logit models, Model specification, estimation and validation; Network analysis, Route or tree building algorithms, Network assignments methods.	08
6	**Sustainable Transportation:** Issues and Guidelines of sustainable transportation, Planning for Mass Transit systems, Planning for Non-Motorized vehicles.	06
	Total	**42**

11. SuggestedBooks:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1	B. G. Hutchinson, "Principles of Urban Transport Systems Planning" Scripta Book Co., Washington	1974
2	Anthony J. Richardson, Elizabeth S. Ampt and Arnim H. Meyburg, "Survey Methods for Transport Planning" Eucalyptus Press, Australia.	1995
3	Roy Thomas, "Traffic Assignment Techniques", Avebury Technical, Aldershot, England	1991
4	C A O'Flaherty, ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

6. Subject Code : **CEN-665** Course Title : **Road Traffic Safety**

7. Contact Hours : **L: 3** **T : 1** **P: 0**

8. Examination Duration(Hrs): **Theory 3** **Practical 0**

9. Relative Weight : **CWS: 20-35** **PRS: 0** **MTE:20-30** **ETE: 40-50** **PRE: 0**

10. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PEC**

12. Pre-requisite: Nil

13. Objective: To introduce the concepts of traffic safety on highways and to make students familiar with related analytical methods and remedial measures.

14. Details of course:

S. No.	Contents	Contact Hours
01	Introduction: Road traffic accidents scenario in India, characteristics of accidents, accident vs. crash, effect of human factors, planning for road network, land use and road environmentforsafety,designingforroadsafety–linksandjunctions,roadsafety engineering, road safety improvement strategies, elements of a road safety plan.	06
02	Crash investigation and analysis: Steps in treatment of crash locations, diagnosing crash problem and solutions, accident report form, storing of data, using and interpreting crash data, identifying and prioritizing hazardous locations, condition and collision diagrams; Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled; Crash reconstruction: understanding basic physics, calculation of speedfor various skid, friction, drag, and acceleration scenarios.	08
03	Statistical analysis of accidents: Descriptive statistics, confidence interval, hypothesis testing, models related to accident frequency, accident severity, accident duration, various methodological issues – over/under dispersion, time-varying explanatory variables, unobserved heterogeneity, endogeneity, under-reporting, spatial and temporal correlation, etc; Accident prediction model.	08
04	Before -after methods in crash analysis: Before and after study, before and after study with control sites, comparative parallel study, before, during and after study, Empirical Bayes method.	04
05	Economic analysis of accidents: Accident costing-economic appraisal, EUAC, PWOC, B/C ratio, IRR, NPV.	04
06	Traffic management system: Traffic flow improvements, expressway patrol, public transit, ridesharing, mobility rest areas, park-and-ride lots, bus bays, signage, markings; ITS applications - vehicular navigation, crash avoidance system, incident management, traffic management centre, highwayside communication.	06
07	Road safety audits: Procedure, aims and objectives, roles and responsibility, history of road safety audit, design standards, tasks, various stages of safety audits; common identifiable problems, structuring of report, identifying common problems.	06
	Total	**42**

11. Suggested books

S. No.	Name of Authors/Books/Publishers	Yearof Publication/ Reprint
1	American Association of State Highway and Transportation Officials (AASHTO), "Highway Safety Manual", 1st Edition, AASHTO.	2010
2	Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, "Statistical and Econometric Methods for Transportation Data Analysis", 2nd Edition, Chapman &Hall/CRC Press,	2010
3	Ezra Hauer, "Observational Before -After Studies in Road Safety", Pergamon Press.	1997

4	Limpert, Rudolf. "Motor Vehicle Accident Reconstruction and Cause Analysis", 5th Edition, Lexas Publishing, Charlottesville, VA.	1999
5	Indian Roads Congress, "Highway Safety Code", IRC: SP-44:1996	1996
6	Indian Roads Congress, "Road Safety Audit Manual", IRC:SP-88-2010	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

1. Subject Code: **CEN-666** Course Title : **Transport Economics**
2. Contact Hours : **L: 3** **T : 1** **P: 0**
3. Examination Duration(Hrs): **Theory 3** **Practical 0**
4. Relative Weight : **CWS: 20-35** **PRS: 0** **MTE:20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PEC**
8. Pre-requisite: Nil
9. Objective of Course: The course provides an outline of demand and supply side concepts and their application to transport policy and planning issues.
10. Details of the Course.

S. No.	Contents	Contact Hours
01	**Introduction and Overview:** Basic components of transport, economic development and urban development. Economic theory, transport as an economic activity, demand and supply issues in transportation sector, demand - supply equilibrium, cost and pricing of transport, law of diminishing returns, elasticity and consumer surplus, costs, pricing and subsidy policies, elements of engineering economics.	06
02	**Transportation Demand and Congestion:** Demand - Demand forecasting methods, factors influencing transport demand, direct and cross - price elasticity of demand, factors that cause shifts in demand function; Congestion - Main causes of traffic congestion, Mechanisms to deal with traffic congestion - congestion pricing, road space rationing, capacity expansion.	07
03	**Transport Supply and Regulation:** Supply - Supply of transport services, development of systems supply function; Regulation - Command and control type of regulation, fiscal measures such as road pricing and environmental taxation, safety and economic regulations in the context of transport services provided by public, issues of social, geographical and temporal equity.	06
04	**Transport Costs and Pricing:** Costs-Direct and external costs of transport, concept of generalized costs, social aspects of transport, joint and common costs of infrastructure, average and marginal cost principle, short-term and long-term costs of supply, congestion costs, external costs, Road User Cost and it's components; Pricing- Pricing principles, the marginal cost pricing rule, efficient pricing, cost complexities and cost recovery, peak-load pricing, second-best pricing, Transport subsidies, price discrimination.	10
05	**Appraisal and Evaluation of Transportation Projects:** Feasibility and evaluation, cost, impacts and performance levels, evaluation of alternatives, analysis techniques, cost-benefit analysis, social and financial benefits, Internal Rate of return method for economic and financial viability, valuation of time, measures of land value and consumer benefits from transportation projects, prioritization of projects, multi-criteria decision assessment.	08
06	**Funding and Financing of Transportation Projects:** Methods for raising funds for maintenance, improvement and expansion of transportation networks, taxation and user fee, financing through loans, bonds, PPPs and concessions.	05
	Total	**42**

11. SuggestedBooks:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1	Mccarthy, P.S., "Transportation Economics – Theory and Practice : A Case Study Approach", Blackwell Publishing.	2001
2	E. Quinet, R. Vickerman and R. W. Vickerman, "Principles of Transport Economics", Edward Elgar Publishing.	2004
3	Button, K. J., "Transportation Economics", 3rd Ed., Edward Elgar Publishing.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-667** Course Title: **Transportation Studies and Analysis Lab**
2. Contact Hours: **L:0** **T:0** **P:3**
3. Examination Duration (Hrs.): **Theory 0** **Practical 3**
4. Relative Weight: **CWS:0** **PRS:50** **MTE: 0** **ETE:0** **PRE: 50**
5. Credits: **2** 6. Semester: **Spring** 7. Subject Area: **PEC**
8. Pre-requisite: Nil
9. Objective : To make students conversant with the analysis and design using traffic and transportation planning data, either manually or using a dedicated software
10. Details of the Course:

S.N.	Contents	Contact Hours
	Observational Studies	**18**
1	Traffic Volume and Intersection/ Turning Movement Study	
2	Spot Speed, Travel Time and Delay Study	
3	Origin Destination Study and Household Survey	
4	Parking and Pedestrian Study	
5	Accident and Traffic Noise Study	
	Software Based Analysis	**24**
6	Alignment and Profile Design	
7	Four-Step Travel Demand Estimation	
8	Video-metric Volume and Speed Analysis	
9	Logit Analysis and Modelling	
	Total	**42**

11. SuggestedBooks

S.N	Name of Authors/Books/Publishers	Year of Publication
1.	Roger P Roess, Elena S Prassas, William R McShane, "Traffic Engineering" 4th Ed, Prentice Hall.	2011
2.	May, A.D., "Fundamentals of Traffic Flow", Prentice Hall, Inc. 2nd Ed.	1990
3.	C JotinKhisty and B Kent Lall, 'Transportation Engineering – An Introduction", Prentice Hall India	2006
4.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2008
5.	Relevant software available in IIT Roorkee	

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Dept.: **Department of Civil Engineering**

1. Subject code: **CEN-668** Course Title: **Multi-agent transport simulation framework**
2. Contact hours: **L: 0** **T: 0** **P: 3**
3. Examination duration (hrs): **Theory 0** **Practical 3**
4. Relative weight: **CWS: 0** **PRS: 50** **MTE: 0** **ETE: 0** **PRE - 50**
5. Credits: **2** 6. Semester: **Spring** 7. Subject area: **PEC**
8. Pre-requisite: Nil
9. Objectives of the course: To Introduce agent-based simulation and its applications regarding co-evolutionary algorithms, dynamic traffic assignment, transport economics and travel behavior analysis, and policy inferencing.
10. **Details of the course:**

S. No.	Contents	Contact hours
1	**Introduction to MAT Sim:** Writing first program, basics of Java; coordinate system, MAT Sim controller, inputs	6
2	**Input generation:** network generation, travel demand generation, facilities, behavioral parameters, GIS and importance in travel demand	8
3	**Network loading algorithm:** queue model, mixed traffic simulation, kinematic wave model, computational performance	6
4	**Transport economics:** utility function, user welfare and system welfare, dependency of choices on household income and other related attributes	7
5	**Re-planning:** choice dimensions (time choice, route choice, mode choice etc.) and their impact	7
6	**Analysis:** reading and analyzing events, generating plots using events, detailed analysis using other software packages	8
	Total	42

11. **Software:**
    a. **MAT Sim:** an open-source software
    b. **VIA:** a commercial product for visualization of software outputs
    c. **QGIS:** an open-source GIS software

12. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Stefania Bandini, Sara Manzoni, Giuseppe Vizzari, "Agent based modeling and Simulation"	2012
2	Klügl, Franziska, Bazzan, Ana, Ossowski, Sascha (Eds.), "Application of agent technology in Traffic and Transportation	2005
3	Andreas Horni, Kai Nagel, Kay W. Axhausen, "The multi-Agent Transport Simulation"	2016

Item No. 78.17: To consider the following proposals of Department of Hydro and Renewable Energy:

(a) Addition of "Instrumentation Engineering" as eligibility criteria for the admission in M. Tech. (AHES).

(b) Introduction of a new Open Elective Course (OEC) for B. Tech. students- (IAH-303 :Solar Photovoltaic Technology and Applications)

The IAPC in its 70th meeting held on April 02, 2019 recommended the proposal at Sl. No.(a). The IAPC also recommended the proposal at Sl. No.(b) with minor modifications **(Appendix-'A')**.

The above is submitted for the consideration and approval of the Senate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: ALTERNATE HYDRO ENERGY CENTRE

Appendix 'A'
Item No. Senate/78.17

1. Subject Code: **IAH-303** Course Title: **Solar Photovoltaic Technology and Applications**
2. Contact Hours: **L: 3** **T: 0** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**
8. Pre-requisite: **Nil**
9. Objective: To acquaint the UG students with various aspects of solar PV technology and its applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to photovoltaic technology; Scenario and status of solar photovoltaic technology in India and the World; Solar energy mission, policies and financing.	6
2.	Solar radiation – basic concepts, assessment and variability; Photovoltaic meteorology	7
3.	Fundamentals of semiconductors; Structure and working of solar cells; Characteristics and electrical models of solar cells.	7
4.	Overview of solar cell technologies: Silicon solar cell and Thin-film solar cell: Amorphous silicon, Thin polycrystalline silicon, Copper indium, Cadmium telluride.	5
5.	Components of solar PV system: photovoltaic generator; battery; power conditioning and control; Characteristics of solar modules and solar PV systems.	5
6.	Types of photovoltaic systems: grid-connected systems, stand-alone systems, hybrid systems.	6
7.	Design of stand-alone PV plants and grid-connected PV plants: phase, frequency matching and voltage conditioning, power transfer, operation of grid interaction inverter; protection, Operation and maintenance of Solar PV systems.	6
	TOTAL	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication
1.	Mertens, K., "Photovoltaics: Fundamentals, technology and practice", 1st edition, Wiley	2014
2.	Solanki, C. S., "Solar photovoltaics: Fundamentals, technologies and applications", 3rd edition, PHI Learning	2016
3.	Boxwell, M., "Solar Electricity Handbook – 2019 Edition", Greenstream Publishing	2019
4.	Waltz, C., "Photovoltaics: Engineering and Technology for Solar Power", Syrawood Publishing House	2017
5.	Kalogirou, S.A., "Solar Energy Engineering: Processes and Systems", Academic Press	2013
6.	Reddy, P. J., "Science and technology of photovoltaics", 2nd edition, CRC Press	2012

12. Suggested web references for policies: www.mnre.gov.in; websites of state renewable energy development authorities of various states of India

Item No 78.18: To consider and approve the recommendations of award committees for various awards.

(i) Nayyar Award for Excellence in Communication

First prize of Rs 50,000/- :

Mr. Siddharth Chaudhry MBA I Year (Enroll No. 18810073

Second Prize of Rs 30,000/- :

Ms. Tanya Ratra , B. Tech. Chemical Engg. (Enroll No. 16111034)

Third Prize of Rs 20,000/-:

Mr. Utkarsh Yadav, B.Tech. CSE (Enroll No. 16114069)

(ii) Manoj Jain Award for Human Values (Cash Prize of Rs. 50,000/- and a trophy) :Mr. Singh Rahulkumar Sunil, B.Tech. III Year MMED (Enroll No. 16118081)

(iii) BhagwanDevatma Award for Excellence in Social Service (Cash Prize of Rs. 20,000, and a medal) :Ms. Sakshi, B.Tech. III Year Chemical Engg. (Enroll No. 16112076)

(iv) Sh. Pandit Shiv Dayal Singh Memorial Award for Excellence in Social Service (Cash Prize of Rs. 20,000, and a medal) : Mr. Vishvendra Singh, Int. M.Tech. Geophysical Technology III Year (Enroll No. 16411032)

Item No 78.19: To consider and approve awardees for various non-convocation awards.

NAME OF Award/ SCHOLARSHIP	CRITERIA OF SCHOLARSHIP	NAME OF STUDENT	ENROLLMENT NO.	GENDER	C.G.P	BRANCH
Tara Chand Scholarship	Tara Chand Kanti Devi Cash Prizes of Rs. 2500/- to the student scoring highest C.G.P.A in B.Tech Civil 3rd Year	NAVNEET KUMAR	15113073	M	9.504	CE
Rai Bahadur Khushi Ram Sud& Smt. Durga Devi Sud Memorial Cash Prize	Rai Bahadur Khushi Ram Sud& Smt. Durga Devi Sud Memorial Cash Prize of Rs. 5000/- for obtaining highest CGPA in B.Tech. (Civil), II Year class	JATIN AGGARWAL	16113041	M	9.495	CE
Lt. Gen. Ram Adhar Loomba Cash Prize (GIRL)	Lt. Gen. Ram Adhar Loomba Cash Prize of Rs. 5000/- for the student who obtains highest CGPA in B.Tech. (Civil) III Year (among girl students)	KANCHAN SHRIVASTAVA	15113057	F	8.267	CE
Kaustubh Roy Memorial Cash Prize	Kaustubh Roy Memorial Cash Prize of Rs. 6000/- for obtaining highest CGPA up to B. Tech. Mech.Engg. III year	PULKIT SINGAL	15119040	M	9.897	ME
Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B.Tech. (CSE/E&C/Elect.) I Year	PURVI AGARWAL	17113096	F	9.511	EE
Rai Singh Jain Cash Prize	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B. Tech. (CSE/E&C/Elect.) II Year	DIVIYA	16115041	F	9.717	EE
Rai Singh Jain Cash Prize	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B.Tech. (CSE/E&C/Electrical) III Yr.	ANKITA SAXENA	15114011	F	9.326	CSE

Rai Singh Jain & Mrs. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Mrs. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech (CSE/E&C/Elect.) I Year	**GHETIA SIDDHARTH**	17114033	M	9.872	CSE
Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech.(CSE/E&C/Elect.)II Year.	**GAJARE PRANJAL MATHU**	16115043	M	9.848	EE
Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech. (CSE/E&C/Elect.) III Year.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Prof. P. Mukhopadhyay Cash Prize	Prof. P. Mukhopadhyay Cash Prize of Rs. 2000/- for obtaining highest CGPA in B.Tech. (Elect.) III year.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Shri RaghurajBehariMathur Cash Prize (M)	Shri RaghurajBehariMathur Cash Prize of Rs. 20,000/- for a male student who has obtained highest CGPA amongst male students in B. Tech. Civil I year	**ADITYA HRIDAY UPADHYAY**	17113005	M	9.787	CE
Shri RaghurajBehariMathur Cash Prize (F)	Shri RaghurajBehariMathur Cash Prize of Rs. 20,000/- for a female student who has obtained highest CGPA amongst female students in B. Tech. Civil I year	**SAKSHI GUPTA**	17113105	F	8.787	CE

GauriShanker – Malti Prize	GauriShanker – Malti Prize of Rs. 10,000/- for the student who obtains highest CGPA in B.Tech. (Civil) III Year.	**NAVNEET KUMAR**	15113073	M	9.504	CE
Dr. G. Pande Gold Medal	For obtaining highest CGPA in M.Sc. (Previous) examination.	**SHARANYA SARKAR**	17610020	F	9.864	M.Sc Biotech.
Air CmdrShyam Chand Mehra	Air CmdrShyam Chand Mehra Scholarship" of Rs. 10,000/- to a girl student of B.Tech 1st year for obtaining highest CGPA in B.Tech. Electrical Engg.	**PURVI AGARWAL**	17113096	F	9.511	EE
Air CmdrShyam Chand Mehra	Air CmdrShyam Chand Mehra Scholarship" of Rs. ~~15~~10,000/- to a girl student of B.Tech. 2nd year for obtaining highest CGPA in B.Tech. Electrical Engg.	**DIVIYA**	16115041	F	9.717	EE
Air CmdrShyam Chand Mehra	"Air CmdrShyam Chand Mehra Scholarship" of Rs. ~~10~~15,000/- to a girl student of B.Tech. 3rd year for obtaining highest CGPA in B.Tech. Electrical Engg.	**AAYUSHI SHRIVASTAVA**	15115002	F	8.89	EE
EC-72 Batch" Cash Award	EC-72 Batch" Cash Award of Rs. 10,000/- for the student of 3rd year B.Tech. (E & CE) based upon performance of the student up to 2nd year.	**SIDHARTH THOMAS**	16112087	M	9.761	ECE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 1st year on the basis of Academics Performance of Autumn Semester .	**MOHIT KUMAR**	18114049	M	10	CSE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in	**SHUBHAM JOHRI**	17312025	M	9.956	MSM

	Engineering 2nd year on the basis of Academics Performance upto 1st year.					
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 3rd year on the basis of Academics Performance upto 2nd year.	**GAJARE PRANJAL MATHU**	16115043	M	9.848	EE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 4th year on the basis of Academics Performance upto 3rd year.	**PULKIT SINGAL**	15119040	M	9.9	ME
Vinay K. and Sunita Jain Award	"Vinay K. and Sunita Jain Award" for Excellence in B.Tech. and IDD programmes in E & CE/CSE/Elect. Engg., related to Information and Communication Technologies (ICT) of Rs. 5,000/- for Fourth year male student on the basis of performance up to 3rd year. In case the recipient is receiving another award at the same time, the award should go to next performer.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Vinay K. and Sunita Jain Award	"Vinay K. and Sunita Jain Award" for Excellence in B.Tech. and IDD programmes in E & CE/CSE/Elect. Engineering related to Information and Communication Technologies (ICT) of Rs. 5,000/- for Fourth year Female student on the basis of performance up to 3rd year. In case the	**ANKITA SAXENA**	15114011	F	9.326	CSE

	recipient is receiving another award at the same time, the award should go to next performer.					
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the First Cash Prize of Rs. 20000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 3rd year on the basis of weightage upto 75% having highest CGPA upto 2nd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME).	**JOSE ABY**	16117039	M	9.511	ME
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the Second Cash Prize of Rs. 10000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 3rd year on the basis of weightage upto 75% having highest CGPA upto 2nd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME).	**RiteshRanjan**	16117071	M	9.733	ME
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the First Cash Prize of Rs. 25000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 4th year on the basis of weightage upto 75%	**PULKIT SINGAL**	15119040	M	9.9	ME

	having highest CGPA upto 3rd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis &Design (ME) and (4) Principles of Industrial Engineering (ME).					
Ajit Singh Yadav Memorial Proficiency Prize	"Ajit Singh Yadav Memorial Proficiency Prize" the Second Cash Prize of Rs. 15000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 4th year on the basis of weightage upto 75% having highest CGPA upto 3rd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME) and Principles of Industrial Engineering (ME)	**Anjanroop Singh**	15117010	M	9.35	ME
Ajit Singh Yadav Memorial Proficiency Prize	"Ajit Singh Yadav Memorial Essay Prize" for two best essays from all departments at IIT Roorkee. The topic for the essay shall be decided by the Institute for each year.	**Ist- SakshiPriya 2nd- SanskarChordiya**	Ist- 16111030 2nd- 17117075	Ist- Female 2nd- Male		Ist- Biotechnology 2nd- Mechanical
DwarkaDassBalwant Kaur Thapar Cash Prize	DwarkaDassBalwant Kaur Thapar" Cash Prize Rs. 6000/- to M.Tech. (AHES) Ist year student highest CGPA but not getting any other award of similar or higher amount.	**GautamNarula**	17512005	M	8.526	
Ashwani Kumar Goel, ALEO Manali Hydropower Award	'Ashwani Kumar Goel, ALEOManali Hydropower Award" of Rs. 10,000/- to a student having second highest CGPA among	**Ayush Jain**	17512003	M	9.158	AHES

	M.Tech. (AHES) I year students.					
Chattishgarh State Power Generation Corporation Hydro Awards	"Chattisgarh State Power Generation Corporation Hydro Awards" of Rs. 10,000/- p.a. to B.Tech. 3rd/ 4th Student for Securing Highest Marks in the Subject IAH-01 SHP Development for Autumn Semester	**Vivek Dhaka**	16113119	M	78	IAH
Mr. Harish Ms. VeenaMidha Cash Prize	Mr. Harish & Ms. VeenaMidha Cash Prize of Rs. 10,000/- to a student of M.B.A. (HRM) I Year Student.	**SahilJatele**		M	83.2	MBA
Balmar Lawrie Cash Prize	Balmar Lawrie Cash Prize of Rs. 10,000/- to Technology Management.	**SahilJatele**		M	80.5	MBA
Bihar Hydro Awards	Bihar Hydro Awards of Rs. 10,000/- to a student Securing Highest C.G.P.A. in M.Tech. I Year Student.	**Namgay Tenzin**	17512012	M	9.474	AHES
Excellence Award by 1972 batch	Excellence Award by 1972 batch of Chemical Engg. Scholarship Rs. 15,000/- for 2nd and 3rd Year (Innovative Mind, Total highest Marks, Business IQ, Sports)	**1. Shivani Singh** **2. Pushkal Sharma**	1. 16112081 2. 15112065	1. F 2. M		Chemical
Om Prakash Gupta and Sushila Devi Memorial Scholarship	Om Prakash Gupta and Sushila Devi Memorial Scholarship of Rs. 10,000 to a girl student of B.Tech. I Year obtaining highest marks.	**DISHA BHATIA**	17112024	F	9.532	Chemical
Prof. B.S. Varshney Memorial Cash Prize	Prof. B.S. Varshney Memorial Cash Prize of Rs. 5,000 for Securing highest grades in the following two subjects: CH 206 Application of Th. CH 204 Transfer Process I (Heat Trans).	**SAKSHI**	16112076	F		CHEMICAL

Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs10,000/- to M.Tech. AHES I year – Securing highest CGPA in the I year and not awarded any other award of same or higher amount	Iqbal	17512008	M	9.474	AHES
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs 10,000/- M.Tech. EMRL I year – Securing highest CGPA in the I year and not awarded any other award of same or higher amount	YashveerJayra	17513010	M	8.611	EMRL
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs10,000/- M.Tech. AHES I year – Securing highest marks in the Seminar	Namgay Tenzin	17512012		92	AHES
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs 10,000/- M.Tech. EMRL I year – Securing highest marks in the Seminar	KetanSonkar	17513007		82	EMRL
Usha Annual Award	Cash Prize of Rs10,000/- M.Tech. AHES I year – Securing highest grade in Small Hydro Power Planning & Management Course	Namgay Tenzin	17512012		83	AHES

Item No.78.20: To consider and approve an award for Time Management.

Nayyar Award For Excellence in Time Management:

Mr. MohinderNayyar (IITR Alumnus, B.E. Mechanical, 1966) wishes to create a corpus to promote excellence among students in terms of effective time-management. The award would recognize and honour the ability of a student to carry out multiple activities simultaneously and show significant improvement in some of them without compromising on the others. The activities may be as diverse as possible including academic grade points, sports, cultural, hobbies, technical, leadership, social service, etc.

Eligibility

Student should have completed 2 years in IIT Roorkee.

Selection Process

(1) Interested students will submit a brief description on why they deserve this award.
(2) Applicant should mention SGPAs of all the previous semesters.
(3) Applicant should mention semester-wise involvement in various activities and demonstrate efficient management of time in multiple activities.
(4) Application must accompany supporting documents for the claims made.
(5) Applications will be reviewed and short listed by an award committee.
(6) The award committee will invite shortlisted applicants to make a presentation and will recommend up to five winners.

Number of awards: up to 5 awards @ Rs. 50,000/- per winner may be given in a year.

Item No. 78.21: To consider the requests of students regarding (A) continuation of program in spite of not fulfilling minimum SGPA, (B) semester withdrawal on medical ground, (C) extension beyond permissible limit and (D) 2nd mercy appeal.

Category A: Continuation of program inspite of not attaining minimum SGPA

1. Mr. Ashish Chakrawarty (Enr. No. 18537003), M.Tech. (HY), I Year.
2. Mr. Alvin Reddy (Enr. No. 18537020), M.Tech (HY), I Year.
3. Mr. Prakriti Sarkar (Enr. No. 18526009), M.Tech. (EQ), I Year.
4. Mr. Agni Bhattacharjee (Enr. No. 18525001), M.Tech. (EQ), I Year.
5. Mr. Anurag Meena (Enr. No. 18519002), M.Tech. (CE), IV Year.

The IAPC in its 69th meeting recommended the requests. The students have been provisionally allowed to register and attend the classes. Their registration is subject to recommendation of IAPC and approval of Senate.

Category B: Semester withdrawal on medical ground

1. Mr. Rohit Kumar (En.No. 18547012), M.Tech. (WRDM), I Year.

The student could not apply for semester withdrawal on account of medical grounds before the commencement of ETE. He, however, did not appear in any examination. He has now requested for semester withdrawal. The IAPC in its 69th meeting has recommended the request.

Category C: Extension beyond permissible limit

1. Ms. Parul (Enr.No. 11116034), B.Tech.(EC), IV Year.
2. Mr. Rakesh Kumar Meena (Enr.No. 10113084), B.Tech. (CE), IV Year.

The students listed in **Category-C** had earlier been granted extension beyond permissible limit. Their extension was valid only up to Autumn Semester 2018-19. Students could not complete their degree requirements citing medical reasons and have requested for further extension. The IAPC in its 69th meeting has opined that in spite of further extension, it would be difficult for the students to complete the credit requirement.

Category D: Continuation of studies in spite of name struck off

1. Ms. Mamta Meena (Enr. No. 14115069), B.Tech. (EE), IV Year
2. Mr. Jaikant Niwariya (16116024), B.Tech. (ECE) III Year
3. Mr. Nitish Kumar (16115079), B.Tech. (EE) III Year
4. Mr. Bhethala Sai Sujith(17119011), B.Tech.(MIED) I Year

In **Category-D,** the names of the students have been struck off due to non-fulfilment of minimum earned credit as per the decision taken in 76th meeting of the Senate. The students have requested for reconsideration through 2nd mercy appeal. The appeal of student at Sl. No.1 was considered by the IAPC in its 69th meeting and the appeals at Sl. Nos. 2 to 4 were considered in its 70th meeting. The resolutions of IAPC are as under:-

Appeal at Sl. No. 1-IAPC recommended that the student be allowed to continue studies on medical ground in view of new information provided by the student.

Appeal at Sl. No. 2 & 3- IAPC did not recommended the continuation of the student's program.

Appeal at Sl. No. 4 - IAPC recommended the request of the student.

The requests **(Appendix 'A')** are submitted for the consideration of the Senate.

Appendix 'A'
Item No. Senate/78.21

DETAILS OF STUDENTS' REQUESTS/ APPEALS

S. No	Name	Details	Recommendations	Supporting Documents
Category- A: Continuation of Program in spite of not fulfilling minimum SGPA				
1.	**Ashish Chakrawarty** M.Tech (HY) (Enr No 18537003)	-Health issue (Jaundice) -SGPA: 4.200 -Detained in 2 subjects due to shortage of attendance -Grades: B, C, C+	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	Medical documents verified by the CMO
2.	**Alvin Reddy** M.Tech (HY) (Enr No 18537020) (Foreign student- Fiji)	-SGPA: 4.200 -Failed in one subject -Grades: D, D+, D+, D+	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	N/A
3.	**Prakriti Sarkar** M.Tech. (EQ) (Enr. No. 18526009)	-SGPA: 4.211 -Failed in one subject - Grades: C+, D, D, D+	Department: recommended IAPC: recommended	N/A
4.	**Agni Bhattacharjee** M.Tech. (EQ) (Enr. No. 18525001)	-SGPA: 4.632 -Failed in one subject - Grades: C, D, C, C	Department: recommended IAPC: recommended	N/A
5.	**Anurag Meena** M.Tech. (CE) (Enr. No. 18519002)	-Health issue of mother -SGPA: 4.952 - Grades: D, D+, C	Department: recommended IAPC: recommended	Medical documents
Category-B: Semester withdrawal on medical ground				
1.	**Rohit Kumar** M.Tech (WRDM) (Enr No 18547012)	-Health issue (Surgery) -SGPA: 0.000 -Did not appear in any exam	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	Medical documents verified by the CMO

Category-C: Extension beyond permissible limit				
1.	**Parul** B.Tech (EC) (Enr No 11116034)	-Health issue (Sciatica) -CGPA: 4.986 -TEC: 147 -Balance Credits: 53 -SGPAs: 2.417, 2, 0, 2.714, 2.920, 2.667, 0.857, 3.367, 4, 1.35, 3.714, 3.304, 4.273, 4.286, 0 Credits earned in extension period : 0	Department: forwarded Wellness Centre: recommended IAPC: not recommended	-Medical documents
2.	**Rakesh Kumar Meena** B.Tech (CE) (Enr No 10113084)	-Health issue -CGPA: 4.867 -TEC: 147 -Balance Credits: 48 -SGPAs: 0.667, 2.643, 1.538, 0.571, 2.129, 4.385, 0.727, 2.667, 4.364, 2.526, 0.273, 0, 1.226, 2.030, 1.371, 0, 4.238, 0 Credits earned in extension period : 0	Department: recommended IAPC: not recommended	-Nil
Category- D: 2nd Mercy Appeal				
1.	**Mamta Meena** B.Tech (EE) (Enr No 14115069)	-Health issue -CGPA: 3.457 -TEC: 62 -Balance Credits: 106 -SGPAs: 6.048, 6.538, 0, 0, 0.462, 1.929	Department: recommended Wellness Centre: recommended IAPC: recommended	-Medical documents

2.	**Jaikant Niwariya** B.Tech (ECE) (Enr No 16116024) **(Request to Continue studies)**	- 2nd mercy appeal with new information regarding his father's health (heart attack) and poor financial condition - Health issue (Dengue & Hepatitis B) - Earlier his mercy appeal was not approved by Senate vide letter No. Acd./584/UG-15 dated Jan. 09, 2019	Department: forwarded Wellness Centre: recommended IAPC: not recommended	-Medical documents verified by the CMO
		-TEC till last Sem (Spring 17-18) - 44 - Min Required- 46 - CGPA- 2.786 - SGPA- 5, 3.250, 2.217, 0		
3.	**Nitish Kumar** B. Tech (EE) (Enr No. 16115079) **(Request to Continue studies)**	- 2nd Mercy appeal - Name Struck Off vide No. Acd./584/UG-15 dated Jan 09, 2019 on the decision of Senate (76th meeting) - Family problem - TEC till last Sem- 44 - Min Required- 46 - CGPA- 2.756 - SGPA- 4.762, 2.273, 1.913,0.571	Department: recommended Wellness Centre: recommended IAPC: not recommended	Medical document of family member

4.	**Bhethala Sai Sujith** **B Tech (PI)** (Enr No 17119011) **(Request to Continue studies and repeat 1st year)**	- 2nd Mercy appeal with new medical certificate for treatment for longer duration - Name Struck Off vide No. Acd./582/UG-15 dated Jan 09, 2019 on the decision of Senate (76th meeting) - Health Issue (internet traits/social disorder) - TEC till last Sem- 19 - Min Required- 22 - CGPA- 2.513 - SGPA- 2.571,2.444	Department: forwarded Wellness Centre: recommended IAPC: recommended	Medical document

Item No. 78.22: To consider the proposal for provision of admission of foreign nationals in M.Sc. programmes and eligibility criteria.

There is a provision of admission of international students to M. Tech. programme without any requirement of GATE score. However, there are no specific guidelines for the admission of foreign nationals to other masters' programmes. For the next academic session, applications for admission in M.Sc. programmes from foreign nationals through ICCR, Govt. of India have been received.

It is proposed that as per the existing norms for foreign nationals, the applications be sent to the respective academic departments/centres for review. Only those applications recommended by the departments/centres be considered for admission.

The IAPC in its 70th meeting held on April 02, 2019 recommended the proposal and in addition it also recommended that there should be a provision for admission of foreign nationals in all Masters' programmes with the exemption of the requirement of National Level Exams (GATE/JAM/CAT etc.) in line with the existing provision for M. Tech. admission and the seats to be supernumerary.

The above is submitted for the consideration and approval of the Senate.

Item No.78.23: To report adoption of MHRD notification regarding introduction of EWS category in admissions.

Implementation on the MHRD notification **(Appendix 'A')** in this regard has begun.

This is being reported to the Senate.

Appendix 'A'
Item No. Senate/78.23

सत्यमेव जयते

F No: 12-4/2019-U1
Government of India
Ministry of Human Resource Development
Department of Higher Education
*****

Shastri Bhawan, New Delhi
Dated: 17th January, 2019

OFFICE MEMORANDUM

Subject: Reservation for Economically Weaker Sections (EWSs) for admission in Central Educational Institutions.

In accordance with the provisions of the Constitution (One Hundred and Third Amendment) Act 2019, and the reference of Ministry of Social Justice and Empowerment vide OM No. 20013/01/2018-BC-II dated 17th January 2019, enabling provision of reservation for the Economically Weaker Sections (EWSs) who are not covered under the existing scheme of reservations for the Scheduled Castes, the Scheduled Tribes and the Socially and Educationally Backward Classes, it has been decided to provide reservation in admission to educational institutions subject to a maximum of ten per cent of the total seats in each category. This would not apply to the minority educational institutions referred to in clause (1) of Article 30 of the Constitution of India.

2. The provision of reservations to the Economically Weaker Sections shall be in accordance with the directions contained in the OM No. 20013/01/2018-BC-II dated 17th January 2019 of the Ministry of Social Justice & Empowerment and shall be subject to the following:

a) The reservations shall be provided to EWSs for admission in Central Educational Institutions, (as defined in clause (d) of section (2) of The Central Educational Institutions (Reservation in Admission) Act, 2006) from the academic year 2019-20 onwards.
b) The above reservation would not be applicable to the 8 institutions of excellence, research institutions, institutions of national & strategic importance as specified in the Schedule to The Central Educational Institutions (Reservation in Admission) Act, 2006, as amended from time to time, and appended to this OM, and to the minority educational institutions referred to in clause (1) of article 30 of the Constitution.
c) Every Central Educational Institution shall, with the prior approval of the appropriate authority (as defined in clause (c) of section 2 of The Central Educational Institutions (Reservation in Admission) Act, 2006), increase the number of seats over and above its annual permitted strength in each branch of

17/1/19

study or faculty so that the number of seats available, excluding those reserved for the persons belonging to the EWSs, is not less than the number of such seats available, in each category, for the academic session immediately preceding the date of the coming into force of this O.M.

d) Where, on a representation by any Central Educational Institution, the appropriate authority is satisfied that for reasons of financial, physical or academic limitations or in order to maintain the standards of education, the annual permitted strength in any branch of study or faculty of such institution cannot be increased for the academic session following the commencement of this Act, it may permit such institution to increase the annual permitted strength over a maximum period of two years beginning with the academic session following the commencement of this Act; and then, the extent of reservation for the Economically Weaker Sections shall be limited for that academic session in such manner that the number of seats made available to the Economically Weaker Sections for each academic session shall not reduce the number and the percentage of reservations provided for SC/ST/OBC categories.

e) The scheme for implementing the reservation for the EWS shall be displayed on the website of the institution as soon as possible, but no later than 31st March 2019.

3. The Chairman UGC, Chairman AICTE and Chairperson NCTE and the Bureau Heads of the Department of Higher Education in the Ministry of Human Resource Development responsible for management of the Institutions of National Importance are requested to ensure immediate compliance of this OM.

4. This issues with the approval of the Minister for Human Resource Development.

Encl: As above

12/1/19

(Smita Srivastava)
Director

1. **Chairman UGC**
2. **Chairman AICTE**
3. **Chairperson NCTE**
4. **All Bureau Heads of Department of Higher Education**

Copy to:

Chief Secretaries of all State Governments/UTs: with a request to give effect to the provisions of the Constitution (One Hundred and Third Amendment) Act, 2019 for all higher educational institutions funded/aided, directly or indirectly, by the State Government in such manner that the provision for reservation for EWS would become operational from the academic year 2019-20.

Appendix

SCHEDULE

(The Central Educational Institutions (Reservation in Admission) Act, 2006)

S.No.	Names of the Institutions of Excellence, etc.
1.	Homi Bhabha National Institute, Mumbai and its constituent units, namely:-
	(i) Bhabha Atomic Research Centre, Trombay;
	(ii) Indira Gandhi Centre for Atomic Research, Kalpakkam;
	(iii) Raja Ramanna Centre for Advanced Technology, Indore;
	(iv) Institute for Plasma Research, Gandhinagar;
	(v) Variable Energy Cyclotron Centre, Kolkata;
	(vi) Saha Institute of Nuclear Physics, Kolkata;
	(vii) Institute of Physics, Bhubaneshwar;
	(viii) Institute of Mathematical Sciences, Chennai;
	(ix) Harish-Chandra Research Institute, Allahabad;
	(x) Tata Memorial Centre, Mumbai.
2.	Tata Institute of Fundamental Research, Mumbai.
3.	North-Eastern Indira Gandhi Regional Institute of Health and Medical Science, Shillong.
4.	National Brain Research Centre, Manesar, Gurgaon.
5.	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.
6.	Physical Research Laboratory, Ahmedabad.
7.	Space Physics Laboratory, Thiruvananthapuram.
8.	Indian Institute of Remote Sensing, Dehradun.

Item No. 78.24: To report institution of new awards and scholarships.

(1) **Dr. Naresh Chandra Varshneya Scholarship:** Mr. Amit Varshney has created a corpus of Rs12,50,000 to honour and support two deserving students of Integrated M.Sc. Physics program @ Rs. 25,000 (Rupees Twenty Five Thousand only) per year to each student who are meritorious but financially constrained.

Besides the scholarship amount, certificates will also be given to the recipients. These scholarships will be given to first two students from the list of MCM awardee students of Integrated M.Sc. Physics.

(2) **Sh. Pandit Shiv Dayal Singh Memorial Award for Excellence in Social Service:** Lt Col. K.S. Dahiya has created a corpus of Rs 6,00,000/- for an award to honor an engineering student of third year for excellence in Social Service. The award carries a cash prize of Rs. 20,000/- (Rs. Twenty Thousand Only) along with a certificate and a medal.

The selection process would be based on inviting the application from the students at individual level who are actively involved in social service. These applications would be shortlisted by a committee consisting of two institute representatives and one donor representative. The shortlisted candidate will be asked to make a presentation in front of the above committee and the final recommendation will be sent to the Senate for the approval.

(3) **Smt. Santosh Rani Tandon Memorial Award** : Prof Mahesh C. Tandon has created a corpus of Rs 12,50,000/- for an annual award to honour a girl student of B.Tech. Civil Engineering Program who has secured the highest weighted grade point average among all girls in the compulsory courses of structural engineering up to 6th Semester of the program. The award would consist of a cash prize of Rs. 50,000/- (Rs. Fifty Thousand Only) and a certificate.

(4) **Umesh Bajaj Scholarship** :Mr. Umesh Bajaj has created a corpus of Rs 12,50,000/- to honour and support five deserving students @ Rs. 1 0,000 (Rupees Ten Thousand Only) per year to each student who are meritorious but financially constrained students of Electronics and Communications Department. Besides the scholarship amount certificates will also be given to the recipients. These Scholarships will be given to first five

students of B.Tech. II Year who will be getting MCM and are eligible to get only Rs. 10,000/- per year.

(5) **Harsh Wardhan Bhatnagar Award for Excellence in Leadership:** Shri Harsh Wardhan Bhatnagar has created a corpus of Rs12,50,000/- to recognise and honour the leadership skills of students who actively contribute in student campus groups at Bhavans, Department/Centre or Institute level. The award would be given to deserving UG student(s) who have exhibited leadership skills by making exemplary improvements in some recognized group. Two awards of Rs 25,000/- each will be awarded each year.

Eligibility:

1. Applications will be invited from the students who are associated with one or more student campus groups such as, Institute Alumni Relations Cell (IARC), IMG, NCC, EDC, Cultural Council, Technical Council, Hobbies Club, Sports Council, Bhawan Councils, SAC etc.

2. The applicant should be in the 8th Semester of his/her B. Tech./B.Arch. /Integrated M.Sc./IDD/Integrated M.Tech. programs admitted through JEE.

Selection Process:

1. Application should accompany documents about changes improvements by the applicant in the group. It should also accompany a handwritten article on "My Plans to excel in profession and life as a whole".

2. An award committee will invite shortlisted applicants to make a presentation and will recommend upto two winners.

3. Girl student will be given preference in case of a tie.

(6) **B. K. Agrawal Award for Academic Excellence**: Mr. B.K. Agrawal has created a corpus of Rs. 3,20,000/- for an award to honour a 7th semester student with the highest CGPA upto the 6th semester of B. Tech. Chemical Engineering programme. The award will carry a cash prize of Rs. 40,000/-. This award will run for a period of ten years.

(7) **Late Smt. Shanti Devi Scholarship and Late Sh. Tara Chand Sharma Scholarship**: Mr. Ved Pal has created a corpus of Rs. 5,00,000/- to honour and support one female and one male undergraduate students of Electrical Engineering Department. These scholarships will be given to one male and one female students of B. Tech. II year who will be getting MCM and are eligible to get only Rs. 10,000 per year. Each annual scholarship would be of Rs. 10,000 (Rupees Ten Thousand Only).

(8) **Mrs. Swaroop Mathur Scholarship**: Mr. Vikas Rishi has created a corpus of Rs5,00,000/- to honour and support two students of B. Tech. Mechanical Engineering III Year. These scholarships will be given to two who will be getting MCM and are eligible to get only Rs. 10,000 per year. Each annual scholarship would be of Rs. 10,000 (Rupees Ten Thousand Only).

(9) **Munshi Ram Sahai and Rohit Chandra Memorial Scholarship:** Mr. Ramesh Chandra has created a corpus of Rs. 2,50,000 to honour and support an undergraduate student of III year who will be getting MCM and are eligible to get only Rs.10,000 per year. The student will be selected on the basis of highest CGPA among the eligible students. The annual scholarship will be @ Rs. 10,000 (Rupees Ten Thousand only).

Chairman Senate has approved the above awards/ scholarships.

This is being reported to the Senate.

Item No. 78.25: To report the inclusion of a new program elective course (PEC) MAN-528 "Simulation Techniques" in the Integrated M.Sc. (Applied Maths) & M.Sc. (Mathematics) programs.

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal to introduce new PEC and approved it **(Appendix 'A').**

This is being reported to the Senate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Appendix 'A'
Item No. Senate/78.25

NAME OF DEPTT. /CENTRE: **Mathematics Department**

1. Subject Code: **MAN-528** Course Title: **Simulation Techniques**
2. Contact Hours: **L: 3** **T: 0** **P: 2**
3. Examination Duration (Hrs): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS 10-25 PRS 25 MTE 15-25 ETE 30-40 PRE 0**
5. Credits: **4** 6. Semester: **Autumn/Spring** 7. Subject Area: **PEC**
8. Pre-requisite: Knowledge of basic probability and statistics and any programming language
9. Objective: To impart knowledge of some simulation techniques with applications (particularly in finance)

10. Details of Course:

Sl.No.	Contents	Contact Hours
1.	Pseudo-random number generators, generator based on linear recurrences, add-with-carry and subtract-with-borrow generators, non-linear generators, theoretical tests for PRNGs based on recurrence modulo 2, statistical tests	3
2.	General sampling method, inverse transform method, acceptance-rejection method, composition, convolution and other useful identities, generating variates from standard distributions such as normal, gamma, exponential, beta, Poisson, binomial, normal random vector, Box-Muller method	11
3.	Variance reduction techniques, control variate method, antithetic variate method, importance sampling, stratified sampling, Latin hypercube sampling, moment-matching method, conditional Monte Carlo	12
4.	Quasi-Monte Carlo method, basic principles, lattices, digital nets and sequences, solo sequence, Faure sequence, Niederreiter sequence	10
5.	Application in finance, European option pricing under log normal model, randomised quasi-Monte Carlo American option pricing, estimating sensitivities and percentiles	6
	Total	42

11. Suggested Books:

S.No.	Name of the Authors/Books/Publishers	Year of Publication
1.	G. S. Fishman, "Monte Carlo: Concepts, Algorithms, and Applications", Springer	1996
2.	P. Glasserman, "Monte Carlo Methods in Financial Engineering", Springer	2003

3.	C. Lemieux, "Monte Carlo and Quasi-Monte Carlo Sampling", Springer	2009
4.	J. C. Hull, "Options, Futures and Other Derivatives", Prentice Hall	2002
5.	P. E. Kloeden and E. Platen, "Numerical Solution of Stochastic Differential Equations", Springer-Verlag	1992
6.	A. M. Law and W. D. Kelton, "Simulation Modeling and Analysis", McGraw-Hill, inc.	1991
7.	Sheldon Ross, "A First Course in Probability", Pearson	2013

Item No. 78.26: To report the inclusion of a new program elective course (PEC) EEN-614: Bio Medical Robotics.

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal to introduce a new PEC and approved it with minor modifications **(Appendix 'A').**

This is being reported to the Senate.

INDIAN INSTITUTE OF TEHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EEN-614** Course Title: **Bio-Medical Robotics**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 1**

4. Relative Weight: **CWS: 10-25** **PRS: 25** **MTE: 15-25** **ETE: 30-40** **PRE: 0**

5. Credits: **4** 6. Semester: **Spring/Autumn** 7. Subject Area: **PEC**

8. Pre-requisite: **Bio-Medical Instrumentation, Introduction to Robotics, Control Systems Basics**

9. Objective:

To develop competence in designing, developing and controlling bio-medical robots and image guided techniques.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction to Bio-Medical Robotics** Introduction to application and paradigms of Bio-Medical Robots. Basic kinematics concepts – forward, inverse, spatial transformations, joints, degrees of freedom of biological systems. Tendon driven systems.	8
2.	**Minimally Invasive Surgery** Video images in MIS. Teleoperation. Augmented and Virtual Reality.	8
3.	**Image-Guided Interventions** Medical Imaging Modalities – CT, US, MRI. Needling System – Passive and Active Needles – Unicycle, Bicycle Modeling, Design concepts, Actuation involving smart actuator such as Shape Memory Alloy actuators, Image-Guided Feedback Control.	10
4.	**Rehabilitation Robotics** Exoskeletons-Design, Development and Control.	8

	Human Hand Biomechanics – Manipulability analysis, Redundancy resolution. EMG, EEG signal recording and processing using LabView.	
5.	**Current Topics in Bio-Medical Robotics** Haptic Augmentation in Exoskeletons. Robotic Catheters for percutaneous interventions. Unsupervised learning for mapping in Bio-Robots.	8
	Total	42

11. Laboratory Components:

S. No.	Experiments	Contact Hours
1.	Introduction to Laboratory Equipments – Exoskeletons, Ultrasound Imaging Modality and Electromagnetic Tracking System	2
2.	Simulation Study on Robot Dynamics	2
3.	Simulation Study on Robot Kinematics and Control	2
4.	Position Control of a Hand Exoskeleton using Subject's Intention.	2
5.	Force Control of a Hand Exoskeleton in Real-Time LabView Platform.	2
6.	Needle Maneuverability in Tissue Phantom through Image Guidance.	2
7.	Human Hand Biomechanics Study.	2
	Total	14

12. Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Paula Gomes, "Medical robotics: minimally invasive surgery", Woodhead Publishing.	2012
2.	Shane Xie, "Advanced Robotics for Medical Rehabilitation: Current state of the art and recent advances", Springer.	2016
3.	John J. Craig, "Introduction to Robotics Mechanics and Control", 3rd Ed., Pearson Prentice Education.	2005
4.	Mark W. Spong and M. Vidya Sagar, "Robotics Dynamics and Control", 2nd Ed., Wiley Education.	1989
5.	William R. Sherman and Alan B. Craig, "Understanding Virtual Reality, 1st Ed., Interface, Application and Design", Morgan Kaufmann Publication.	2003
6.	Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley and Sons Publication.	2000

Approved & forwarded.

5/4/2019
(DAPC Chairman)

Item No. 78.27: To report the approval on the request of the following student to extend his date of candidacy.

Sl. No	En. No.	Name	D.o.R.	Status	Deptt.	Due Date of Candidacy	Proposed Extension for Candidacy	Remarks	Decision
1.	17925010	Pankaj Singh Rawat	07.07.2017	Full-Time	Physics	06.01.2019	30.04.2019	Due to prolonged illness	Recommended by IRC

On the recommendations of IRC, Chairman Senate has approved the request.

This is being reported to the Senate.

Item No. 78.28: To report adoption of MHRD Office Memorandum with respect to qualification for JRF/SRF and RA.

Implementation on the MHRD Office Memorandum **(Appendix 'A')** in this regard has begun.

This is being reported to the Senate.

F.No. 12-2/2019-U1
Government of India
Ministry of Human Resource Development
Department of Higher Education

Shastri Bhawan, New Delhi
Dated: 31st January, 2019

OFFICE MEMORANDUM

Subject: Revision of emoluments and guidelines on service conditions for research personnel engaged in R&D programme of the Central Government Departments/ Agencies.

The undersigned is directed to refer to OM No. SR/S9/Z-08/2018 dated 30th January 2019 of the Department of Science and Technology, Ministry of Science and Technology, on the subject cited above. The emoluments for research personnel engaged in R&D programmes funded by the MHRD shall be enhanced according to the following provisions:

1) **Emoluments:**

A. **Junior Research Fellow (JRF)/Senior Research Fellow (SRF)**

Sl. No.	Designation & Qualification	Existing Emoluments (per month)	Revised Emoluments (per month)
I	**Junior Research Fellow (JRF)** Post Graduate Degree in Basic Science OR Graduate / Post Graduate Degree in Professional Course selected through a process described through any one of the following: a. Scholars who are selected through National Eligibility Tests - UGC NET including lectureship (Assistant Professorship) and GATE. b. The selection process through National level examinations conducted by MHRD and its Agencies and Institutions such as UGC / IIT / IISc. / IISER / IIIT etc	Rs. 25,000/-	Rs. 31,000/-
II	**Senior Research Fellow (SRF)** Qualification prescribed for JRF with two years of research experience.	Rs. 28,000/-	Rs. 35,000/-

A.1 After completion of two years, an external assessment by the Institution where the student is enrolled for Ph.D is mandatory for upgradation from JRF to SRF. The fellow may be awarded SRF after successful assessment.

A.2 Annual Satisfactory Assessment is mandatory to continue the benefit of fellowship during SRF period.

B. Research Associate

Research associates may be fixed at a consolidated amount at one of the 3 pay levels given below depending upon the qualification and experience. The Institute/Organization concerned may decide the level in which a particular associate should be placed based on the experience. The Essential Qualification (EQ) for RA is as follows:

Ph.D/MD/MS/MDS or equivalent degree or having 3 years of research, teaching and design and development experience after MVSc/M.Pharm/ME/M.Tech with at least one research paper in Science Citation Indexed (SCI) journal.

Sl. No.	Category	Existing Emoluments (per month)	Revised Emoluments (per month)
I	Research Associate –I	Rs. 36,000/-	Rs. 47,000/-
II	Research Associate –II	Rs. 38,000/-	Rs. 49,000/-
III	Research Associate –III	Rs. 40,000/-	Rs. 54,000/-

2. **Service Conditions:**

(i) **DA:** JRFs, SRFs and Research Associates will not be entitled to DA.

(ii) **House Rent Allowance (HRA):** All research fellows may be provided hostel accommodation wherever available. Research fellowship holder residing in hostels shall not be entitled for HRA. Wherever provision of hostel accommodation is not possible, HRA may be allowed to all the above categories viz. JRF, SRF and RA as per Central Government norms applicable in the city/location where they are working. The percentage required for calculating HRA will be based on the fellowship amount.

(iii) **Medical Benefits:** The research fellows and research associates (JRF/SRF/RA) will be entitled for medical allowance as applicable in the implementing institution.

(iv) **Leave and other entitlements:** The JRF/SRF are eligible only for casual leave while Research Associates are entitled to leave as per rules of the host institution. Participation of any of these categories (JRF/SRF/RA) in scientific event/workshops held in India or abroad will be treated as "on duty" with due approval of the host institution. The travel entitlement for JRF/SRF/RA for participation in scientific events/workshops in India will continue to be the same as earlier i.e. 2nd AC by rail. Maternity leave as per the Govt. of India instructions issued from time to time would be available to female candidates in all categories.

(v) **Bonus & Leave Travel Concession:** JRFs, SRFs and Research Associates will not be entitled to these allowances.

(vi) **Retirement Benefits:** JRFs, SRFs and Research Associates will not be entitled to these benefits.

(vii) Publication/Patent: The results of JRF/SRF/RA's research work may be published preferably in standard refereed journals with the concurrence of the Fellow and his/her Supervisor / Advisor. It should be ensured by the fellow that the assistance provided by the funding agency of Government of India is acknowledged in all such publications.

(viii) Obligation of JRF/SRF/RA:

a) He/ She shall be governed by the disciplinary regulations of the host Institute where he/she is working.
b) The JRF/SRF/RA must send a report of the research work done during the period of Fellowship as may be asked by the sponsoring agency.

3. The number of fellowships shall remain the same as is existing, unless modified with the approval of MHRD. The Departments / Agencies are requested to ensure that the above guidelines are followed in regard to the remuneration and other benefits to the research personnel engaged in R&D projects funded by them.

4. Selection for award of fellowship shall ordinarily be through common competitive examinations. However, for subjects where there is no examination presently, Government Departments and their authorized agencies and institutions may start conducting examinations to screen candidates for award of fellowships. This shall not be applied retrospectively and the persons already enrolled shall be exempted.

5. In order to further enhance value, quality and experience in doctoral research, the Government has agreed to incentivize the research output, for e.g. in the form of publications and patents. The proposals to incentivize research output will be considered separately and modalities for its implementation will be evolved.

6. **Date of Effect:** The revised emoluments will take effect from 01.01.2019. The requirement of funds should be worked out and the additionality should be met from the existing budget of 2018-19 through matching savings.

7. The Chairman UGC, Chairman AICTE and the Bureau Heads of the Department of Higher Education in the Ministry of Human Resource Development responsible for management of the Institutions of National Importance are requested to convey this to all the Institutions under their supervision immediately.

8. This issues with the approval of the Minister for Human Resource Development.

Encl: As above

31/1/19

(Smita Srivastava)
Director

1. **Chairman UGC**
2. **Chairman AICTE**
3. **All Bureau Heads of Department of Higher Education**

भारतीय प्रौद्योगिकी संस्थान रूड़की
रूड़की – 247 667 (भारत)
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE - 247 667 (INDIA)

सीनेट की अठत्तरवी बैठक हेतु अनुपूरक कार्य सूची
SUPPLEMENTARY AGENDA FOR THE
78th MEETING OF THE SENATE

बैठक सं0	: अठत्तरवी
MEETING NO.	**: 78th**
स्थान	: सीनेट हॉल, भा0प्रौ0सं0 रूड़की
VENUE	**: Senate Hall, IIT Roorkee**
दिनांक	: 10 अप्रैल 2019
DATE	**: 10th April 2019**
समय	: 3.30 बजे अपरान्ह
TIME	**: 3.30 P.M.**

भारतीय प्रौद्योगिकी संस्थान रूड़की
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
रूड़की 247 667
ROORKEE – 247 667

अनुपूरक कार्यसूची / SUPPLEMENTARY AGENDA

मुद्दा सं0 / **Item No.**	विवरण / **Particulars**	पृश्ठ / **Page(s)**
78.13	प्रोजक्ट स्टाफ का पीएचडी प्रोग्राम में प्रवेश पात्रता के मानदंडों और चयन प्रक्रिया में संशोधन पर विचार करना। To consider the modification in the eligibility criteria and selection process for admission of a Project staff in Ph.D. programme.	41
78.14	77वी सीनेट द्वारा निर्देशित पीएचडी प्रोग्राम की उम्मीदवारी के लिए कोर्स क्रेडिट आवश्यकताओं पर विचार करना। To consider the course credit requirements for candidacy to a Ph.D. programme as directed by the 77th Senate.	42
78.15	शैक्षणिक वर्ष 2019–20 के लिए पीएचडी सहित यूजी और सभी मास्टर कार्यक्रमों के सीट मैट्रिक्स पर विचार करना। To consider the Seat Matrix for UG and all Master Programmes including Ph.D. for the academic year 2019-20.	43-49
78.16	जानपद इंजिनियरिगं विभाग के एमटेक (परिवहन) स्कीम में संशोधन के प्रस्ताव पर विचार करना। To consider the proposal of Department of Civil Engineering regarding modification in the scheme of M. Tech. (Transportation).	50-75
78.17	जल एवं नवीकरणीय ऊर्जा विभाग के निम्नलिखित प्रस्तावों पर विचार करना: (अ) एमटेक (एएचईएस) में प्रवेश पात्रता के लिए "इंस्ट्रुमेंटेशन इंजीनियरिग" को जोडना। (आ) बीटेक छात्रों के लिए एक नया ओपन इलेक्टिव कोर्स (ओईसी) आईएएच–303: सोलर फोटोवोल्टिक टैक्नोलोजी और एपलिकेशन्स शुरू करना ।	76-77

	To consider the following proposals of Department of Hydro and Renewable Energy: (a) Addition of "Instrumentation Engineering" as eligibility criteria for the admission in M. Tech. (AHES). (b) Introduction of a new Open Elective Course (OEC) for B. Tech. students – (IAH-303 : Solar Photovoltaic Technology and Applications)	
78.18	विभिन्न पुरस्कारों के लिए पुरस्कार समितियों की सिफारिशों पर विचार और अनुमोदन करना। To consider and approve the recommendations of award committees for various awards.	78
78.19	विभिन्न गैर दीक्षांत पुरस्कारों के लिए पुरस्कार विजेताओं पर विचार और अनुमोदन करना। To consider and approve the awardees for various non-convocation awards.	79-86
78.20	टाइम मैनेजमेंट के लिए एक पुरस्कार पर विचार और अनुमोदन करना। To consider and approve an award for Time Management.	87
78.21	छात्रों के अनुरोधो पर विचार करना। (अ) अपूर्ण न्यूनतम एसजीपीए की वस्तुस्थिति में कार्यक्रम जारी रखना (ब) मेडिकल ग्राउंड पर सेमेस्टर विड्राल (स) अनुमेय सीमा ौष्चात विस्तार, और (द) द्वितीय दया अपील To consider the requests of students regarding (A) continuation of program in spite of not fulfilling minimum SGPA, (B) semester withdrawal on medical ground, (C) extension beyond permissible limit and (D) 2nd mercy appeal.	88-93
78.22	विदेशी नागरिकों के लिए एमएससी कार्यक्रम में प्रवेश प्रावधान और पात्रता मानदंड के प्रस्ताव पर विचार करना। To consider the proposal for provision of admission of foreign nationals in M.Sc. programmes and eligibility criteria.	94
78.23	प्रवेश में ईडब्लूएस श्रेणी के लिए एमएचआरडी अधिसूचना अपनाने को रिपोर्ट करना। To report adoption of MHRD notification regarding introduction of EWS category in admissions.	95-98
78.24	नए पुरस्कारों और छात्रवृत्ति के प्रतिष्ठापन को रिपोर्ट करना। To report institution of new awards and scholarships.	99-100

78.25	इंटिग्रेटिड एमएससी (एप्लाइड मैथ्स) और एमएससी (गणित) प्रोग्रामों में एक नये प्रोग्राम इलक्टिव कोर्स एमएएन–528 "सिमुलेशन तकनीक" के समावेश को रिपोर्ट करना। To report the inclusion of a new program elective course (PEC) MAN-528 "Simulation Techniques" in the Integrated M.Sc. (Applied Maths) & M.Sc. (Mathematics) programmes.	101-103
78.26	नये प्रोग्राम इलेक्टिव कोर्स (पीईसी) ईईएन – 614 बायो मेडिकल रोबोटिक्स के समावेश को रिपोर्ट करना। To report the inclusion of new Program Elective Course (PEC) EEN-614: Bio Medical Robotics.	104-106
78.27	छात्र के अनुरोध पर उसकी उम्मीदवारी की तिथि विस्तार के अनुमोदन को रिपोर्ट करना। To report the approval on the request of student to extend his date of candidacy.	107

Item No. 78.13: To consider the modification in the eligibility criteria and selection process for admission of a Project staff in Ph.D. programme.

A project staff seeking admission in the Ph.D. programme can be admitted through any of the following procedures:

a. A department/center can select a candidate under project category during regular selection for Ph.D. programme.

b. A project staff appointed on a Research position in an externally funded research project shall be allowed to register in Ph.D. programme if he/she fulfils the eligibility requirements of the Ph.D. program and is selected through the following selection committee of the Department/Center in which the admission is sought:

(i) SRIC Nominee
(ii) Head of the concerned Department/Center or his Nominee
(iii) Concerned Principal Investigator
(iv) One faculty member from outside the Department/Center as available to the PI
(v) Head's nominees (two DRC/CRC members)
(vi) One external expert from outside the Institute if required by the sponsor

IRC in its 28th meeting held on March 28, 2019 recommended the modified admission process for PhD admission of a project staff.

The above is submitted for the consideration of the Senate.

Item No. 78.14: To consider the course credit requirements for candidacy in Ph.D. programme as directed by the 77th Senate.

The IRC in its 28th meeting held on March 28, 2019 deliberated on the proposal in detail and resolved as given in the Table below.

Table: Course credit requirement for candidacy in Ph.D. programme

S. No.	Qualification	Credit Requirements	Remarks
1	M.Tech, M.Arch./MURP, or equivalent	Minimum 12 credits of P.G. level theory courses	a. In addition to minimum credits requirements a student shall take one seminar of 2 credits. b. Student can also take one self-study theory course or an Online course of PG level.
2	M.Sc/M.A./M.B.A.or equivalent, admitted to Science/ HSS/ Management department	Minimum 15 credits out of which at least 12 credits shall be taken from P.G. level theory courses	
3	B.Tech. or equivalent, or M.Sc. or equivalent, admitted to any one of the engineering departments/centres	Minimum of 24credits of P.G. level theory courses	

The above is submitted for the consideration of the Senate.

Item No.78.15: To consider the Seat Matrix for UG and all Masters' Programmes including Ph.D. for the academic year 2019-20.

Vide item No. 69.2.8, IAPC recommended UG Seat Matrix **(Appendix 'A').**

Vide item No. 69.3.1, IAPC recommended M.Tech./ M.Arch./ MURP Seat Matrix **(Appendix 'B').**

Vide item No. 69.2.9, IAPC recommended M.Sc. Seat Matrix **(Appendix 'C').**

Vide item No. 69.2.10, IAPC recommended MBA Seat Matrix **(Appendix 'D').**

Vide item No. 29.2.1, emergent IRC recommended PMRF Seat Matrix in line with the NCC-PMRF **(Appendix 'E').**

The Chairman Senate approved the Ph. D. Seat Matrix for Autumn Semester 2019-20 on the recommendation of 27th IRC. The same is being reported to the Senate.**(Appendix 'F').**

S. No.	Program	Seat Capacity	Gender Neutral	Change in	Modified Seat capacity	Modified	Female excluding Supernumerary	% of EWS	Increase Seat	New Seat Capacity	New Gender Neutral	% Female of C19	Supernumerary	Final Female Only	Final Gender Neutral	Seat including Supernumerary	% of Female in 2019
		C18	GN18	seat capacity	2019	gender neutral	F18		I19	C19	GN19		SN19	F19			
1	Biotech	35	29	0	35	29	6	3	2.2	37.2	30.8	17.13	0	6.4	30.8	37.2	17.13
2	Chemical	90	78	0	90	78	12	3	5.7	95.7	82.7	13.55	4	17.0	82.7	99.7	17.02
3	Civil	135	128	0	135	128	7	3	8.5	143.5	135.1	5.89	20	28.4	135.1	163.5	17.40
4	Comp. Sc.	75	72	0	75	72	3	3	4.7	79.7	75.9	4.77	12	15.8	75.9	91.7	17.23
5	Electrical	120	108	0	120	108	12	3	7.6	127.6	114.3	10.42	11	24.3	114.3	138.6	17.53
6	Electronics	80	71	0	80	71	9	3	5.1	85.1	75.2	11.59	6	15.9	75.2	91.1	17.42
7	Engg. Physics	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
8	Mechanical	100	100	0	100	100	0	3	6.3	106.3	105.2	1.01	21	22.1	105.2	127.3	17.34
9	Metallurgical	80	73	0	80	73	7	3	5.1	85.1	77.2	9.24	8	15.9	77.2	93.1	17.04
10	Polymer	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
11	Production	40	38	0	40	38	2	3	2.5	42.5	40.1	5.71	6	8.4	40.1	48.5	17.37
12	Architecture	30	24	0	30	24	6	3	1.9	31.9	25.6	19.82	0	6.3	25.6	31.9	19.82
13	Geological	30	24	0	30	24	6	3	1.9	31.9	25.6	19.82	0	6.3	25.6	31.9	19.82
14	Geophysical	30	26	0	30	26	4	3	1.9	31.9	27.6	13.55	2	6.3	27.6	33.9	18.65
15	Mathematics	30	28	0	30	28	2	3	1.9	31.9	29.6	7.28	4	6.3	29.6	35.9	17.61
16	Chemistry	20	16	0	20	16	4	3	1.3	21.3	17.0	19.82	0	4.2	17.0	21.3	19.82
17	Physics	20	17	0	20	17	3	3	1.3	21.3	18.0	15.12	1	4.2	18.0	22.3	18.93
	Total	**975**	**884**		**975**	**884**	**91**		**61.6**	**1036.6**	**935.1**		**99**	**200.5**	**935.1**	**1135.6**	

	Please Enter the values in Green Columns (B, C, D, E and I) only	
C18	Seat Capacity 2018 as given in JOSAA website	
GN18	Gender Neutral 2018 as given in JOSAA website	
% of EWS	Percentage of EWS for 2019	

For new programs C and D columns will be zero

For new programes eneter the seat capacity in E

For change in seat capacity enter the difference from last capacity in E

Appendix 'B'
Item No. Senate/78.15

Proposed Seat for M.Tech./M.Arch./MURP Admission 2019-20

S.No	Academic Department/ Centre & (Code)	Academic Programmes		Main Gate Discipline(s)					Other GATE Disciplines					EWS*	Total Seats in Dept/ Centre
		Name	Code	GATE Discipline Code	GEN	OBC	SC	ST	GATE Discipline Code	GEN	OBC	SC	ST		
1	Architecture and Planning (ARD)	M.Arch.	10	AR(12)	6	3	2	1	-	-	-	-	-	1	25
		M.U.R.P.	11	AR(10)	5	2	2	1	CE(2)	1	1	0	0		
2	Alternate Hydro Energy Centre (AHC)	M.Tech. Alternate Hydro Energy Systems	12	CE(2)	1	1	0	0	AG/CH/EE/EC/ME/ PI/XE (13)	7	3	2	1	1	27
		M.Tech. Environmental Management of Rivers and Lakes	13	CE(3)	1	1	1	0	AG/CH/EE/ME/PI/X E/AR/CY/BT/PH/MA /XL/EY(8)	4	2	1	1		
3	Chemical Engineering (CHD)	M.Tech. Chemical Engineering	14	CH(20)	9	6	3	2	-	-	-	-	-	1	21
4	Civil Engineering (CED)	M.Tech. Environmental Engg.	16	CE(11)	5	3	2	1	CH(2)	1	1	0	0	3	91
		M.Tech. Geomatics Engg.	17	CE(7)	3	2	1	1	AR/CS/EC/EE /AG/MN(7)	4	2	1	0		
		M.Tech. Geotechnical Engg.	18	CE(13)	7	3	2	1	MN (2)	1	1	-	-		
		M.Tech. Hydraulic Engg.	19	CE(11)	5	3	2	1		-	-	-	-		
		M.Tech. Structural Engg	20	CE(21)	9	6	4	2	-	-	-	-	-		
		M.Tech. Transportation Engg.	21	CE(14)	7	4	2	1	-	-	-	-	-		
5	Earthquake Engineering (EQD)	M.Tech. Soil Dynamics	22	CE(12)	6	3	2	1	-	-	-	-	-	1	41
		M.Tech. Structural Dynamics	23	CE(18)	9	5	3	1	-	-	-	-	-		
		M.Tech. Seismic Vulnerability and Risk Assessment	24	CE(10)	5	3	1	1	-	-	-	-	-		
6	Electrical Engineering (EED)	M.Tech. Electric Drives & Power Electronics	25	EE(15)	8	4	2	1	-	-	-	-	-	2	62
		M.Tech. Instrumentation and Signal Processing	26	EE(10)	5	3	1	1	EC/IN(5)	3	1	1	0		
		M.Tech. Power System Engg.	27	EE(15)	7	5	2	1	-	-	-	-	-		
		M.Tech. Systems and Control	28	EE(11)	5	3	2	1	EC/IN(4)	1	1	1	1		
7	Electronics and Communication Engineering (ECD)	M.Tech. Communication Systems	29	EC(12)	6	3	2	1	-	-	-	-	-	1	34
		M.Tech. R.F. & Microwave Engg	30	EC(10)	5	3	1	1	-	-	-	-	-		
		M.Tech. Microelectronics and VLSI	31	EC/PH(11)	5	3	2	1	-	-	-	-	-		
8	Computer Science and Engineering (CSD)	M.Tech. Computer Science & Engg	32	CS(31)	15	9	5	2	-	-	-	-	-	1	32
9	Hydrology (HYD	M.Tech. Hydrology	33	CE/AG(18)	9	5	3	1	GG/XE/PH/ EY(3)	1	1	0	1	1	22
10	Mechanical and Industrial Engineering (MED)	M.Tech. CAD, CAM & Robotics	34	ME/PI(12)	6	4	1	1	-	-	-	-	-	2	60
		M.Tech. Machine Design Engg.	35	ME/PI(12)	6	3	2	1	-	-	-	-	-		
		M.Tech. Production & Industrial Systems Engg.	36	ME/PI(12)	6	3	2	1	-	-	-	-	-		
		M.Tech. Thermal Engg.	37	ME/PI(11)	5	3	2	1	-	-	-	-	-		
		M.Tech. Welding Engg.	38	ME/PI(11)	5	3	2	1	-	-	-	-	-		
11	Metallurgical and Materials Engineering (MTD)	M.Tech. Industrial Metallurgy	39	MT(3)	2	1	0	0	ME/PI/XE (8)	4	2	1	1	1	23
		M.Tech. Materials Engg.	40	MT(4)	2	1	1	0	PH/ME/PI/CY/XE (7)	3	2	1	1		
12	Paper Technology Saharanpur Campus (PPD)	M.Tech. Pulp & Paper	41	CH(8)	4	2	1	1	ME/BT/TF/EY (4)	2	1	1	0	1	26
		M.Tech Packaging Technology	42	CH(7)	3	2	1	1	BT/CY/ME/TF (6)	3	2	1	0		
13	Water Resources Development and Management (WRD)	M.Tech. Irrigation Water Management	43	CE/AG(8)	4	2	1	1	-	-	-	-	-	1	21
		M.Tech. Water Resources Development	44	CE/EE/ME (12)	5	4	2	1	-	-	-	-	-		
15	Physics (PHD)	M.Tech. Solid State Electronic Materials	46	PH(7)	3	2	1	1	EE/EC/MT (3)	2	1	0	0	1	21
		M.Tech. Photonics	47	PH(7)	3	2	1	1	EE/EC/MT/IN (3)	1	1	1	0		
16	Nanotechnology (NTC)	M.Tech. Nanotechnology	48	MT/ME/EC/CH/BT/ CE (4)	2	1	1	0	CY/PH/XL (6)	2	2	1	1	1	11
17	Disaster Mitigation and Management (DMC)	M.Tech. Disaster Mitigation and Management	49	CE(5)	2	1	1	1	ME/PI/CS/CH/AR/G G/PH/MA/XL/XE/EY /BT (5)	2	2	1	0	1	11
18	Transportation Systems (TSC)	M.Tech. Infrastructure Systems	50	CE(3)	1	1	1	0	ME/PI/CH/EE/EC/C S/ AR (7)	3	2	1	1	1	11
19	Biotechnology (BTD)	M.Tech. Bioprocess Engineering	51	CH (5)	2	1	1	0	BT/AG/XE/TF (5)	2	2	1	1	1	11
		Total			204	119	68	36		47	30	15	9	22	550

* EWS seats will be allotted to the candidates with any eligible GATE discipliine in the department/programme as per merit.

Appendix 'C'
Item No. Senate/78.15

Intake for M.Sc. for 2019-20

S.No.	DEPTT	CODE	PROGRAMME	TOTAL	GEN	OBC	SC	ST	PD 5% Horizontal
1	Earth Science **(ES)**	1801	M.Sc. (Applied Geology)	15	8	4	2	1	0
2	Biotechnology **(BT)**	1802	M.Sc. (Biotechnology)	37	18	10	6	3	G-1, B-1, T-1
3	Chemistry **(CY)**	1803	M.Sc. (Chemistry)	45	23	12	7	3	G-1, B-1, C-1
4	Mathematics **(MA)**	1804	M.Sc. (Mathematics)	30	15	8	5	2	G-1
5	Physics **(PH)**	1805	M.Sc. (Physics)	25	12	7	4	2	G-1
6	Humanities & Social Sciences **(HS)**	1806	M.Sc. (Economics)	30	15	8	5	2	G-1
			Total	182	91	49	29	13	9

Seat Matrix for MBA programme 2019-20

Programme	Intake	GEN	OBC	SC	ST	PD
MBA	95	48	26	14	7	5% Horizontal

Appendix 'E'
Item No. Senate/78.15

Proposed seat matrix for admission to Ph.D. Programme under PMRF (July 2019)

Name of the Department	PMRF Discipline	Intake
	Agriculture and Food Engineering	
Architecture and Planning	Architecture and Regional Planning	4
Biotechnology	Biological Sciences	5
	Biomedical Engineering	
Chemical Engineering	Chemical Engineering	2
Chemistry	Chemistry	4
Civil Engineering	Civil Engineering	8
Computer Science	Computer Science	2
• Electrical Engineering • Electronics & Communication Engineering	Electrical Engineering (including ECD)	7
	Engineering Design	
• Hydro and Renewable Energy • Applied Science and Engineering • Center for Transportation Systems • Centre for Disaster Mitigation & Management • Centre for Nanotechnology • Earth Sciences • Earthquake Engineering • Electronics and Communication Engineering • Hydrology • Paper Technology • Polymer and Process Engineering • Water Resources Development and Management	Interdisciplinary Programs in Science and Engineering (AHC, ASE, TSC,DMC, NTC, ESD, EQD, HYD, PPD, PPE, WRD)	15
Metallurgical and Materials Engineering	Material Science and Metallurgical Engineering	4
Mathematics	Mathematics	3
Mechanical & Industrial Engineering	Mechanical	6
	Mining, Mineral, coal and Energy sector	
	Ocean Engineering and Naval Architecture	
Physics	Physics	4
	Textile Technology	
	TOTAL	**64**

Appendix 'F'
Item No. Senate/78.15

Category wise vacancy i.e. 27% for OBC, 15% for SC, 7.5% for ST and 3% for EWS category for admission to Ph.D program for Autumn Semester of the session 2019-20 under Institute Assistantship

Deptt/ centre	Faculty Position (01.01.19)	Total seats @4.0 x no. of faculty	Increased with 6.37%	Category wise Total Seats					Seats Filled					Vacancy					
				Gen	Gen-EWS	OBC	SC	ST	Gen	OBC	SC	ST	Total filled	Total vacancy	Gen	EWS* 3%	OBC	SC	ST
(Roorkee Campus)																			
AHEC	5	20	21	10	1	6	3	1	6	7	3	1	17	4	3	1	0	0	0
Arch & Plng	18	72	77	36	2	21	12	6	28	14	10	0	52	25	8	2	7	2	6
Biotechnology	26	104	111	53	3	30	17	8	46	15	4	1	66	45	7	3	15	13	7
C-Trans	4	16	17	8	1	5	2	1	10	3	2	1	16	4	1	1	2	0	0
Dis. Mit. &Magnt	4	16	17	8	1	5	2	1	6	4	1	1	12	5	2	1	1	1	0
Nanotechnology	4	16	17	8	1	5	2	1	7	4	1	0	12	5	1	1	1	1	1
Chemical Engg	19	76	81	39	2	22	12	6	23	23	12	1	59	22	15	2	0	0	5
Chemistry	24	96	102	48	3	28	15	8	32	11	9	0	52	50	16	3	17	6	8
Civil Engg	43	172	183	87	5	49	28	14	75	44	22	5	146	37	12	5	5	6	9
Computer Sc. & Engg	12	48	51	24	2	14	7	4	15	5	4	0	24	27	9	2	9	3	4
Earth Sciences	22	88	94	45	3	25	14	7	34	9	3	1	47	47	11	3	16	11	6
Earthquake Engg	12	48	51	24	2	14	7	4	19	8	1	2	30	21	5	2	6	6	2
Electrical Engg	30	120	128	61	4	34	19	10	49	22	7	0	78	50	12	4	12	12	10
E&CE	22	88	94	45	3	25	14	7	24	14	3	0	41	53	21	3	11	11	7
Hum &Soc. Sciences	15	60	64	30	2	17	10	5	20	16	7	1	44	20	10	2	1	3	4
Hydrology	8	32	34	16	1	9	5	3	12	2	1	1	16	18	4	1	7	4	2
Inst. Instr. Centre	1	4	4	2	0	1	1	0	0	1	0	0	1	3	2	0	0	1	0
Management Studies	14	56	60	28	2	16	9	5	27	9	7	0	43	17	1	2	7	2	5
Mathematics	26	104	111	53	3	30	17	8	21	21	9	0	51	60	32	3	9	8	8
Mech&Indl Engg	42	168	179	85	5	48	27	14	61	37	25	5	128	51	24	5	11	2	9
Met & Mat Engg	21	84	89	42	3	24	13	7	26	20	12	1	59	30	16	3	4	1	6
Physics	36	144	153	73	5	41	23	11	44	22	5	1	72	81	29	5	19	18	10
WRD & M	5	20	21	10	1	6	3	1	8	3	2	0	13	8	2	1	3	1	1
Total	**413**	**1652**	**1759**	**835**	**55**	**475**	**262**	**132**	**593**	**314**	**150**	**22**	**1079**	**683**	**243**	**55**	**163**	**112**	**110**
(Saharanpur Campus)	Total Seat @ 8 x no. of faculty																		
Applied Sc. & Engg	4	32	34	16	1	9	5	3	14	7	1	0	22	11	2	1	2	4	2
Paper Technology	5	40	43	20	1	12	7	3	17	5	5	0	27	14	3	1	6	1	3
Polymer & Process Engg	12	96	102	49	3	27	15	8	32	14	11	0	57	42	17	3	12	3	7
Total	**21**	**168**	**179**	**85**	**5**	**48**	**27**	**14**	**63**	**26**	**17**	**0**	**106**	**67**	**22**	**5**	**20**	**8**	**12**

*** Note: if the cut-off for GEN is X, it should not go below 0.9X for OBC/EWS and 0.67X for SC/ST/PD based on IRCresolution No. 28.2.13**

Item No. 78.16: To consider the proposal of Department of Civil Engineering regarding modification in the structure of M. Tech. (Transportation).

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal and recommended it with modifications **(Appendix 'A').**

The modified structure and syllabi is submitted for the consideration of the Senate.

DEPARTMENT OF CIVIL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program code: 21 M. Tech. (Transportation Engineering)
Department: CE Civil Engineering
Year: I

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester – I (Autumn)														
1	CEN-561	Traffic Analysis and Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-562	Pavement Analysis and Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
3	CEN-563	Urban Mass Transit Systems	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4	CEN-564	Geometric Design	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
5	-	Program Elective – I	PEC	3/4	3	1	-	3	-	20-35	-	20-30	40-50	-
		Total		19/20										
Semester – II (Spring)														
1	CEN-664	Transportation Planning	PCC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-700	Seminar	SEM	2	0	0	2		-	-	-	-	100	-
3		Program Elective – II	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4		Program Elective – III	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
5		Program Elective - IV	PEC	3/4	3	1	-	3	-	20-35	-	20-30	40-50	-
6		Program Elective - V	PEC	2	-	-	3	-	3	-	50	-	-	50
		Total		19/20										

DEPARTMENT OF CIVIL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program code: 21 M. Tech. (Transportation Engineering)
Department: CE Civil Engineering
Year: II

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester – I (Autumn)														
1	CEN-701A	Dissertation Stage-I (to be continued in Spring semester)	DIS	12	-	-	-	-	-	-	-	-	100	-
		Total		12										
Note: Student can take 1 or 2 audit courses as advised by the supervisor, if required														
Semester – II (Spring)														
1	CEN-701B	Dissertation Stage-II (to be continued in Spring semester)	DIS	18	-	-	-	-	-	-	-	-	100	-
		Total		18										

Summary				
Semester	1	2	3	4
Semester wise total credits	19/20	19/20	12	18
Total credits	68/70			

Programme Elective Courses (Transportation Engineering)

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Courses Against Autumn Semester Electives														
1	BM-513	Business Statistics	PEC	3	3	-	-	3	-	25	-	25	50	-
2	CEN-501	Environmental Modelling and Simulation	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
3	CEN-513	Remote Sensing and Digital Image Processing	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
4	CEN-521	Advanced Numerical Analysis	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
5	CEN-522	Advanced Soil Mechanics	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
6	CEN-543	Advanced Concrete Design	PEC	4	3	0	2	3	-	10-25	25	15-25	30-40	-
7	CEN-545	Finite Element Analysis	PEC	4	3	-	2	3	-	10-25	25	15-25	30-40	-
8	CEN-565	Planning, Design and Construction of Rural Roads	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
9	CEN-566	Airport Planning and Design	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
10	CEN-567	Transportation Systems Analysis	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
11	CEN-568	Advanced Highway Material Characterisation	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
12	CTN-501	Quantitative Techniques for Infrastructure Systems	PEC	4	3	-	2	3	-	15	25	20	40	-

Courses Against Spring Semester Electives														
1	CEN-604	Environmental Impact and Risk Assessment	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
2	CEN-614	Theory and Application of GIS	PEC	4	3	-	2	3	-	10-25	25	15-25	30-40	-
3	CEN-621	Advanced Geotechnical Exploration and Testing	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
4	CEN-661	Advanced Highway Construction and Maintenance	PEC	4	3	1	2/2	3	-	15-30	20	15-25	30-40	-
5	CEN-662	Intersection Design and Analysis	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
6	CEN-663	Pavement Evaluation and Management	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
7	CEN-665	Road Traffic Safety	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
8	CEN-666	Transport Economics	PEC	4	3	1	-	3	-	20-35	-	20-30	40-50	-
9	CEN-667	Transportation Studies and Analysis Lab	PEC	2	-	-	3	-	3	-	50	-	-	50
10	CEN-668	Multi-Agent Transport Simulation Framework	PEC	2	-	-	3	-	3	-	50	-	-	50

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **CIVIL ENGINEERING**

1. Subject code: **CEN-561** Course Title: **Traffic Analysis and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester: **Autumn**
7. Subject Area: **PCC** 8. Pre-requisite: **Nil**
9. **Objective:** To introduce the advances in traffic engineering analysis and design and to make the students conversant with relevant field applications.

10. Details of Course:

S. No.	Particulars	Contact Hours
1	Introduction: Elements of traffic engineering, issues for traffic engineers; road users, vehicles, highways and control devices.	04
2.	Traffic Stream Characteristics: Traffic stream parameters, Time Space diagram, relationship among q,k,u, Macroscopic Fundamental Diagrams (MFD).	04
3.	Traffic Studies: Traffic volume studies, speed, travel time and delay studies, parking studies, RSI Survey, WTP Survey, accident data collection, pedestrian studies.	04
4.	Traffic design: Capacity analysis concepts – urban streets and rural highways, design of parking facilities, street design.	06
5.	Statistical application in Traffic Engineering: Overview of Probability Functions and Statistics, Normal Distribution and application, Confidence Bounds, Sample Size, Binomial Distribution, Poisson Distribution, Hypothesis Testing.	08
6.	Microscopic Modeling: Classification of Time Headway, Random Headway State, Constant Headway State, Intermediate Headway State, Car Following Theory.	06
7.	Time Series Analysis: Basic Components of Time Series, Smoothening and Decomposition Methods, Data Filters, Auto Correlations and Moving Averages.	04
8.	Management Techniques: Traffic calming; Congestion and road user pricing; priority movements; traffic regulations and control systems; use of intelligent systems.	06
	TOTAL	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	William R. Mcshane and Roger P. Roess, "Traffic Engineering", Pearson (4^{th} Edition).	2013
2.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2012
3.	C A O'Flaherty, Ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA	2006
4.	May, A.D., "Fundamentals of Traffic Flow", Prentice Hall, Inc. 2^{nd} Ed.	1990
5.	Carlos F. Daganzo. "Fundamentals of Transportation and Traffic Operations", Pergamon	1997
6.	Simon P. Washington, Matthew G. Karlaftis and Fred L. Mannering, "Statistical and Econometric Methods for Transportation Data Analysis", Second Edition, CRC Press	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Civil Engineering Department**

1. Subject Code:**CEN-562** Course Title: **Pavement Analysis and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge to students related to analysis and design with respect to Highway Pavement.
10. Details of Course:

S. No.	Particulars	Contact Hours
1.	**Introduction:** Components of pavement structure, importance of subgrade soil properties on pavement performance. Functions of subgrade, subbase, base course and wearing course.	**4**
2.	**Stresses in Pavements:** Flexible pavements - Stresses in homogeneous masses and layered systems, deflections, shear failures, equivalent wheel and axle loads; Rigid pavements - Westergaard's and Thomlinson's analysis of warping stresses, Combination of stresses due to different causes, Effect of temperature variation on Rigid Pavements	**8**
3.	**Design Elements of Flexible Pavements:** Loading characteristics-static, impact and repeated loads, effects of dual wheels and tandem axles, area of contact and tyre pressure, modulus or CBR value of different layers, equivalent single wheel load, equivalent stress and equivalent deflection criterion, equivalent wheel load factors, climatic and environmental factors.	**6**
4.	**Design Methods for Flexible Pavements:** California bearing ratio (CBR) adopted in various countries, IRC: 37-2018, AASHTO Design Guide, Triaxial method, Boussinesq's and Burmister's analysis, Pavement designing software (IITPAVE, KENPAVE, MICH-PAVE); Design of flexible pavements for low volume roads.	**8**
5.	**Rigid Pavements:** Design of rigid pavement using IRC: 58-2015 and AASHTO guidelines, Wheel load stresses, Role of modulus of subgrade reaction, Westergaard's analysis, Bradbury's approach Arlington test, Pickett's corner load theory and charts for liquid, elastic and soil of finite and infinite depths of subgrade.	**8**
6.	**Types of Concrete Pavements:** Roller Compacted Concrete Pavement, Plain Jointed Concrete Pavement, Continuously Reinforced Concrete Pavement, Prestressed concrete pavement, Design of Tie Bars and Dowel Bars, Role of Dry Lean Concrete; Rigid pavement design for low volume roads	**8**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Yoder, E.J. and Witczak, M.W., "Principles of Pavement Design 2nd Ed", John Wiley & Songs, Inc.	1975
2	O'Flaherty, A. Coleman, "Highways : the Location, Design, Construction and Maintenance of Road Pavements", 4th Ed., Elsevier	2006
3	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press Taylor &Francies Group.	2006
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering Nem Chand Jain & Bros, 8th Ed.	2005
5	Papagiannakis, A.T. and Masad, E.A., "Pavement Design and Materials, John Wiley & Sons Inc.	2008
6	Yang H. Huang, " Pavement Analysis and Design" Second Edition, Pearson Education Inc.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Civil Engineering**

1. Subject Code: **CEN-563** Course Title: **Urban Mass Transit Systems**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PCC**
9. Objective of Course: To introduce the students to urban mass transit systems, their types, suitability, planning, operation and management aspects.
10. Details of the Course.

S. No.	Course Description	Contact hours
01	**Introduction**: Mass transit systems, Elements / components of transit systems; Urban Mass Transit systems, types, characteristics, suitability and adaptability of these systems; Evolution of urban transportation.	3
02	**Transit System Planning**: Planning needs; Short-range and long-range planning; Planning procedures and methodology, Data collection; Medium performance transit systems and high-performance transit systems; trends in transit planning.	6
03	**Transit Demand Estimation and Evaluation:** Transit demand forecasting; transit mode evaluation; comparison and selection of most suitable transit mode.	8
04	**Transit System Operations:** Basic operational elements; transit travel characteristics; transit scheduling; transit line analysis – planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity.	10
05	**Transit Networks and System Analysis:** Transit networks – types and their characteristics; transfers in transit networks; system analysis in transit – conceptual models, modeling procedures; terminal or station location planning – issues, objectives, station spacing decisions.	8
06	**Economics and Financing of Transit Systems:** Transit system performance and economic measures; transit fares – structure, collection and levels; financing of transit services; public and private integration of transit services.	6
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Vukan R. Vuchic, "Urban Transit – Operations, Planning and Economics", John Willey and Sons, Inc., USA	2004
2	Vukan R. Vuchic, "Urban transit systems and technologies", John Willey and Sons, Inc., USA	2007
3	C A O'Flaherty, 'Transport Planning and Traffic Engineering', Butterworth-Heinemann, Burlington	2006
4	C JotinKhisty and B Kent Lall, "Transportation Engineering" Prentice-Hall of India Pvt Ltd., New Delhi	2003

NAMEOFDEPTT/CENTRE: **Department of Civil Engineering**

1. Subject Code:**CEN-564** Course Title : **Geometric Design**
2. Contact Hours : **L: 3 T : 1 P: 0**
3. Examination Duration(Hrs): **Theory 3 Practical 0**
4. Relative Weight : **CWS: 20-35 PRS: 0 MTE: 20-30 ETE: 40-50 PRE: 0**
5. Credits: **4** 6.Semester: **Autumn** 7. Subject Area :**PCC**
8. Pre-requisite: **Nil**
9. Objective: To introduce concepts and design procedures for different types of roads and associated facilities.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Design Controls - Topography and physical features, traffic, vehicular characteristics, speed and safety; Space standards for urban, rural and hill roads, Sight distance requirements, Access controls	6
2.	**Cross-section Elements :** Single lane, Two lane, Multi-lane highways, Expressways, Urban roads; Street design concepts, bicycle tracks, pedestrian facilities, street furniture, Design of Speed Breaker	6
3.	**Alignment :** Horizontal Alignment - Curve design, Super-elevation design, Transition curve design, Attainment of super-elevation, Pavement widening, Sight distance on horizontal curves; Vertical Alignment - Gradients, Grade compensation, Design of vertical curves, Combination of horizontal and vertical alignment, vertical clearance for underpasses and elevated structures	6
4.	**Highway Capacity:** Two lane, Four lane, Six lane non-urban highways, Urban roads, Expressways, HCM USA and IRC Specifications	8
5.	**Intersection Geometry:** Visibility requirements, Principles of channelization, Layout design for types of intersections, on-ramps and off-ramps (flyovers and Access controlled facilities), Acceleration and deceleration lanes, Two-way turn lanes,	6
6.	**Design of Facilities:** Design of on-street and off-street parking facilities, multi-storyed Parking; Design of bus shelters and bus lay-bye, Bus terminal, Truck terminals and truck lay-bye, Container terminal, Toll Plaza, Foot-over bridge and sky-walk	10
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Wright, P.H. & Dixon, K.K., "Highway Engineering", 7th Ed., John Wiley & Sons.	2004
2.	Transportation Research Board (TRB), Highways Capacity Manual, National Research Council, Washington D.C.	2010
3.	Khisty, C.J. and Lal, B.K., "Transportation Engineering - An Introduction", Prentice Hall of India Pvt. Ltd.	2006
4.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2008

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN- 565** Course Title: **Planning, Design and Construction of Rural Roads**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE:40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the concepts of Planning, Geometric Design, Pavement Design, Construction and Maintenance of Rural Roads
10. Details of the Course:

S. No.	Course Description	Contact hours
01	**Planning of Rural Roads**: Classification of Roads, Brief introduction to earlier 20 year Plans, System's Approach, NATPAC Model, Gravity Model, CRRI Model, FBRNP Model, Concepts of PMGSY	08
02	**Geometric Design**: Geometric Design Standards for Rural Roads with special reference to PMGSY, Hill Road Standards.	04
03	**Pavement Design:** Various pavement design methods for Rural roads including Flexible and Rigid pavements using IRC:SP-20, IRC-72, IRC-37, IRC:SP-62, CRRI Nomograms	04
04	**Mix Design Methods:** CRRI Method, Triangular Chart Method, Fuller's Method, Rothfuch method, PI based Method	06
05	**Materials:** Brief introduction to conventional materials, Marginal and Waste Materials including Fly Ash, GBFS, BFS, SMS, Bagasse, CRMB, etc	06
06	**Construction:** Case Studies of Waste Material Utilization in Rural Roads, Low Cost Techniques for Rural Road Construction, Tractor Bound Technology, Special Considerations for Hill Areas	06
07	**Drainage:** Transverse and Longitudinal Drainage, Design of drains, Minor CD Works, Filter Design etc.	04
08	**Maintenance:** Type and Causes of Failures, Remedies	04
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Rural Roads Manual , SP-20, IRC	2002
2	Document on Rural Road Development, Vol I & II, CRRI	1990
3	PMGSY Operation Manual, NRRDA, Govt of India	2005
4	Specifications for Rural Roads, MoRD, IRC	2004
5	Khanna S.K., Justo C.E.G,, Highway Engineering, Nem Chand & Bros, Roorkee	2004
7	Quality Assurance Handbook for Rural Roads, NRRDA, Govt. of India	2007

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-566** Course Title: **Airport Planning and Design**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To familiarize students on various techniques related to airport planning and design.
10. Details of the Course.

S. No.	Course Description	Contact hours
01	**Airport Planning:** Airport master plan, aircraft characteristics related to airport planning and site selection, air traffic demand analysis, planning surveys, airport zoning.	08
02	**Geometric Design:** Airport classification, runway and taxiway geometric standards, exit taxiways, separation and clearances.	06
03	**Terminal Areas:** Facilities, space requirement, number and size of gate positions, aircraft parking system.	06
04	**Visual Aids :** Airport day time markings, airport lighting, visibility, visual aids	03
05	**Structural design of airport pavements:** Design Factors, Design of flexible and rigid pavements	06
06	**Airside capacity and delay:** Mathematical models for capacity and delay, space time concept, models for mixed traffic	06
07	**Air Traffic Control:** Importance of flight rules, navigational aids, air traffic controls, obstruction and clearance requirements	04
08	**Airport Drainage :** Design run-off, inlet size and location design, surface and subsurface design	03
	Total	**42**

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	Robert Horonjeff and Francis X. McKelvey, "Planning & Design of airports, McGraw Hill, Inc, 4th edition	1993
2	S. K. Khanna, M. G. Arora and S. S. Jain, "Airport Planning & Design", Nem Chand and Bros, Roorkee	2000
3	Ashford, N. and Wright, P. H., "Airport Engineering, Wiley, 3rd edition.	1992
4	ICAO, "Aerodrome design manual", International Civil Aviation Organization, Montreal, Canada	1983

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Civil Engineering**

1. Subject Code: **CEN- 567** Course Title: **Transportation Systems Analysis**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the students to the analysis of different transportation systems, their components, operations, systems analysis approaches and economics.
10. Details of the Course:

S. No.	Course Description	Contact hours
01	**Introduction**: Scope of transportation and impact on society; System planning process and problem solving process; transportation problems.	06
02	**Transportation Technologies**: Transportation technologies, suitability and adaptability; Transportation system components; Transportation system characteristics – technological and operational; Path – vehicle interaction; Volume – Density relationship for containers.	10
03	**Analysis of Systems:** Generation of alternatives; Performance evaluation of system and performance functions; Operational planning and analysis of components; Transportation network analysis and Minimum path algorithms; Travel in space and time; Planning for non-motorized transportation; Freight transportation planning–models and methods; Residential location choice models, Car-ownership models; transportation software.	12
04	**Transportation Economics:** Transportation demand and supply; Equilibrium between supply and demand, transportation system equilibrium; Elasticity – direct and cross; concept of consumer surplus; transport demand models – sketch planning, incremental demand model, model estimation from traffic counts; transportation cost, travel – market equilibrium.	08
05	**Sustainable Transportation Planning:** Sustainable transportation – issues and principles; non-motorized transportation planning; Impact evaluation and impact models.	06
	Total	42

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	Marvin L Manheim, "Fundamentals of Transportation Systems Analysis", The MIT Press, Cambridge, Massachusetts	1980
2	AdibKanafani, "Transportation Demand Analysis", McGraw Hill Inc, New York, U.S.A.	1983
3	Steenbrink, P.A., Optimization of Transport Network, John Wiley & Sons, NY.	1974
4	Konstadinos G Goulias, "Transportation System Planning – Methods and Applications", CRC Press, London	2002
5	C JotinKhisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi	2003
6	Thomas A Domencich and Daniel McFadden, "Urban Travel Demand – A Behavioural Analysis", North-Holland Publishing Company, Amsterdam	1975

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-568** Course Title: **Advanced Highway Material Characterisation**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weight **CWS 15-30** **PRS 20** **MTE 15-25** **ETE 30-40** **PRE 0**
5. Credits: **4** 6. Semester **Autumn**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the advanced technologies in pavement engineering materials and to make the students conversant with characterization of various conventional and alternative road construction materials.
10. Details of the Course.

S. No.	Course Description	Contact hours
1	**Soil:** Classification of soil, Identification and strength tests- Atterberg limits, compaction tests, California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS), Modulus of subgrade reaction, Resilient Modulus, Permeability, Free Swelling Index (FSI), Deleterious materials, sand equivalent test, Soil stabilization techniques.	06
2	**Aggregates:** Origin and Classification, physical, mechanical and durability properties, sampling techniques, aggregate texture and skid resistance, Polish Stone Value, Alkali-aggregate reactivity.	06
3	**Binders:** (i) **Bitumen**: Bitumen sources and manufacturing, Bitumen constituents and its properties, Structure and Rheology, tests on bitumen-emulsions & cutback, modified bitumen and its types, goals of modification, properties of modified bitumen, separation test, long-term and shorter aging of bitumen, Elastic recovery test of modified bitumen (ii) **Cement**: Origin, composition, Types of cement, physical properties of cement (consistency, setting times, soundness and strength of cement), flow test.	10
4	**Bituminous and Concrete Mix Designs:** Design of Granular Sub-base and their desirable properties; Design of Wet Mix Macadam and their desirable properties; Design of Bituminous Mixtures & reports- Desirable properties of mixes, Moisture susceptibility, stripping value, Fillers, Theory of fillers and specifications; Marshall Method MS-2; Foamed Asphalt Mix Design; Cold Mix Design. Concrete Mix Design - Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes, porosity of concrete; Dry Lean Concrete; Pavement Quality Concrete (PQC)	12
5	**Alternative Pavement Materials:** Recycled Concrete aggregates, Reclaimed asphalt pavement materials, use of industrial and agricultural wastes for pavement construction, chemical and mineral admixtures	08
	Total	**42**

LABORATORY TESTS

S. No.	Course Description
1	**Soil and Aggregate testing:** Free Swelling Index (FSI) and Deleterious material content, CBR test, Unconfined Compression test, Sand equivalent test, aggregate polishing and skid resistance test, soundness test.
2	**Straight-run bitumen/Modified bitumen Tests:** Penetration value test, Elastic recovery test of binders & Dynamic Shear Rheometer (DSR)
3	Formulation of design mixes for sub-base and unbound base course (Granular Sub-base & Wet mix Macadam)

4	**Bituminous Mixture:** Proportioning of aggregates, preparation of test specimens, and testing, formulations of bituminous mixtures (conventional bituminous mixtures for bound base courses
5	**Concrete mixes:** Proportioning of aggregates, preparation of test specimens, and testing, design of dry lean concrete mix, design of pavement quality concrete mix
6	**Alternative pavement materials:** Design of cement treated sub-base and base using reclaimed asphalt pavement materials.

Suggested Books:

S. No	Authors / Title / / Publisher	Year of publication
1	P. Kumar Mehta, Paulo J.M. Monteiro, "Concrete microstructure, properties, and materials, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.	2006
2	Dr. L.R. Kadyali and Dr. N.B. Lala, "Pricnciples and Practices of Highway Engineering", Khanna Publishers, New Delhi.	2010
3	Paul H. Wright and Karen K. Dixon, " Highway Engineering" Seventh EditionJohn Wiley & Sons, Inc.	2004
4	Yang H. Huang, "Pavement Analysis and Design", Second Edition, Pearson Prentice Hall.	2004
5	T.F. Fwa, "The Handbook of Highway Engineering", CRC, Taylor & Francis Group.	2006
6	S.K. Khanna, C.E.G. Justo and A.Veeragavan, "Highway Engineering" Revised 10th Edition, Nem Chand & Bros., Roorkee.	2015
7	Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-661** Course Title: **Advanced Highway Construction and Maintenance**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weight **CWS 15-30 PRS 20 MTE 15-25 ETE 30-40 PRE 0**
5. Credits: **4** 6. Semester **Spring**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To introduce the advances in highway construction and evaluation, making the students conversant with the different construction and evaluation techniques.
10. Details of the Course.

S. No.	Course Description	Contact hours
1	**Embankment & Subgrade** Setting Out. Clearing and Grubbing, Road formation width, Borrow Pits, Quarries, Construction under special cases, Embankment Construction, Subgrade construction, Backfilling, Preparation of cut formation, Surface and subsurface drains.	06
2	**Flexible Pavements** ***Subbase:*** Granular Subbase (GSB): ***Unbound Courses:*** Water Bound Macadam (WBM), Wet Mix Macadam (WMM); ***Bound Courses:*** Bituminous Macadam (BM), Dense Bituminous Macadam (DBM); ***Wearing Courses:*** Bituminous Concrete (BC), Semi Dense Bituminous Concrete (SDBC).	06
3	**Cement Concrete Pavement** Dry Lean Concrete (DLC), Roller Compacted Concrete Pavement (RCCP), Pavement Quality Concrete (PQC), Continuously Reinforced Concrete Pavement (CRCP), Cement Concrete Pavement Construction Techniques: Manual, Automated (Fixed Form, Slip Form).	10
4	**Highway Maintenance & Evaluation:** Need of Highway maintenance, methods of maintenance for flexible and rigid pavement layers; Load man, Different Types of Falling Weight Deflectometers (FWD) for evaluation of rigid and flexible pavements, Distress Modes - Cracking, Ruttingetc. Factors influencing deflections, Back-calculation of Pavement Layer Moduli and detection of loss of bonding of cement concrete pavements using FWD data; Destructive Structural Evaluation; Different Methods of NDT(Working Principles): Benkelman Beam, Pavement Safety Evaluation: Skid Resistance, Purposes, functional Evaluation: Serviceability concepts, Distress types: Bituminous and Concrete pavements; Visual Rating; PSI; Methods of Measuring Roughness:	08
5	**Quality Control in Highway Construction:** Execution and quality control prior to construction, during construction and post construction: Standard deviation, mean, normal distribution, control chart – Quality audit of finished pavement – Performa of quality assurance records.	06
	Total	42

LABORATORY TESTS:

S. No.	Course Description
1	**Aggregate testing:** Aggregate polishing value and skid resistance test
2	**Straight-run bitumen/Modified bitumen Tests:** Emulsion and Cutback, PAV (Pressure ageing vessel) and RTFOT (Rolling thin film oven test) – video class & demonstration, bitumen viscosity test (Rotational viscometer) – video class & demonstration
3	**Bituminous Mixture:** Resilient modulus of bituminous mixture (video class & demonstration), foamed asphalt mixture, cold mixture), fatigue and rutting tests (video class and demonstration)

4	**Concrete mixes:** Abrasion resistance test on hardened concrete (video class & demonstration), Concrete permeability test, Mercury Intrusion Porosimetry (MIP) –video class & demonstration
5	**Highway Maintenance related experiments:** Benkelman Beam tests, Merlin Test, Falling Weight Deflectometer, Axle Load Survey, Roughness survey of roads using Roughometer

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	HouXiangshen, Ma Songlin, "Highway maintenance and management" China communication Press.	2016
2	Sanford Eleazer Thompson, "Concrete in Highway Construction- A text book for highway engineers and supervisors" Forgotten Books Publisher	2018
3	Dr. L.R. Kadiyali and Dr. N.B. Lala, " Principles and Practices of Highway Engineering", Khanna Publisher.	2005
4	Richard Robinson, Uno, Danielson, Martin Snaith, "Road Maintnenance Management" Concepts and Systems, Palgrave publisher	1998
5	KandhalPrithvi Singh, "Bituminous Road Construction in India", PHI Learning Private Limited, Delhi- 110092.	2016

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-662** Course Title: **Intersection Design and Analysis**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration **Theory 3** **Practical 0**
4. Relative weightage **CWS 20-35** **PRS 0** **MTE 20-30** **ETE 40-50** **PRE 0**
5. Credits: **4** 6. Semester **Spring**
7. Prerequisite: NIL 8. Subject Area: **PEC**
9. Objective of Course: To discuss various methods of design and analysis of different types of road intersections and interchanges.
10. Details of Course

Sl No.	Topics to be covered	Contact hours
1	Types of intersections, Principles of design, types of maneuvers, relative speed, conflict points and area	6
2	Intersection geometrics and their influence on design/operation	3
3	Operational analysis of two-way and all-way stop controlled intersections and roundabouts by US and Indian methods, mini roundabouts	6
4	Analysis of signal controlled intersections by US, British and Swedish methods, delay and its evaluation	12
5	Types of signals, Design of signals by Indian, US and British methods, signal coordination	6
6	Grade separated intersections and interchanges	4
7	Weaving sections and their operational evaluation	3
8	Intersection signs, marking and lighting	2

Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication
1	Transportation Engineering & Planning, by C. S. Papacostas and P. D. Prevedouros, Prentice Hall of India Private Limited, New Delhi	2001
2	Principles of Highway Engineering and Traffic Analysis, by Fred L Mannering, Walter P. Kilareski and Scott S. Washburn, Wiley India Edition	2007
3	Transportation Engineering, by C. JotinKhistya and B. Kent Lall Prentice Hall of India Private Limited, New Delhi	2006
4	Transport Planning and Traffic Engineering, by C A O Flaherty, Hodder Headline Group, London	1997
5.	Highway Capacity Manual of US, by Transportation research Board, Washington DC	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Civil Engineering Department**

1. Subject Code: **CEN-663** Course Title: **Pavement Evaluation and Management**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory 3** **Practical 0**
4. Relative weightage **CWS 20-35** **PRS 0** **MTE 20-30** **ETE 40-50** **PRE 0**
5. Credits: **4** 6. Semester: **Spring** 7.Subject Area: **PEC**
8. Pre-requisite: Nil
9. Objective: To provide knowledge related to Evaluation and Management with respect to Road Development.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Pavement Evaluation:** General concept of pavement evaluation, Evaluation of pavement performance; Evaluation of pavement structural capacity; Evaluation of pavement distress - Structural and functional, serviceability, fatigue cracking, pavement deformation and low temperature shrinkage cracking; Evaluation of pavement safety – Skid resistance, measurement, variation with time, traffic and climate, control.	**6**
2.	**Pavement Performance Evaluation:** Factors affecting performance, relation between performance and distress; Visual ratings, PSI, Methods of measuring roughness, response and profile; IRI – Quarter Car Model, riding number; Pavement performance prediction models for flexible and rigid pavements.	**6**
3.	**Pavement Structural Evaluation:** Different methods of NDT - Benkelman Beam, Bump Integrator, Dynaflect, LaCroixDeflectometer, Road Ratar, Rolling Dynamic Deflectometer, Loadman, Falling weight deflectometers; Factors influencing deflection; Back calculation of Pavement Layer Moduli; Flexible overlays and determination of overlay thickness. Rigid overlays and determination of overlay thickness. Design of Overlay by Benkelman Beam and Falling Weight Deflectometer.	**12**
4.	**Design Alternatives – Analysis, Evaluation and Selection:** Framework for pavement design, design objectives and constraints, Basic structural response models, characterization of physical design inputs, Generating alternative pavement design strategies. Economic evaluation of alternative pavement design strategies, analysis of alternative design strategies. Predicting distress, predicting performance, selection of optimal design strategies.	**6**
5.	**Pavement Management System (PMS):** Components and related activities, steps in implementation of a PMS; Design, construction and maintenance; Rehabilitation and Feedback data system; Examples of Working Design and Management Systems; Evaluation of alternate strategies and decision making; Techniques, tools and use of expert system in PMS.	**8**
6.	**Pavement Maintenance Management:** Components and related activities, Budgeting, Maintenance strategies and prioritization, Pavement life cycle cost analysis – components and methods.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Hass, R., Hudson, W.R. and Zaniewski, J. "Modern Pavement Management" Krieger.	1994
2	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press, Taylor &Francies Group.	2006
3	Shain, M.Y., "Pavement Management for Airports, Roads and Parking Lots", Kluwer Academic Publishers Group.	2004
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering" Nem Chand & Bros,	2005

	Roorkee (U.A.) 8th Ed.	
5	Hudson, W.R., Haas, R. and Uddin, W., "Infrastructure Management", McGraw Hill.	1997
6	Hass R. & Hudson, W.R., "Pavement Management System", Mc Graw Hill Company, Inc. New York	1978

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

1. Subject Code :**CEN-664** Course Title : **Transportation Planning**
2. Contact Hours : **L: 3** **T : 1** **P: 0**
3. Examination Duration(Hrs): **Theory 3** **Practical 0**
4. Relative Weight : **CWS: 20-35** **PRS: 0** **MTE:20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PCC**
8. Pre-requisite: **Nil**
9. Objective of Course: To introduce the concept of travel demand modeling using four-stage sequential transportation planning.

10. Details of the Course.

S. No.	Contents	Contact Hours
1	**Introduction to Transportation**: Fields of Transportation, Role in Society, System-Environment Ensemble, Transportation Problems	05
2	**Planning Process**: Hierarchical Structure; Characteristics and objectives of planning, Problem solving and its morphology, Planning methodologies; Overview of urban transportation planning; Urban structure interaction and concepts.	08
3	**Transportation Data:** Data needs and sources; Survey methodology, Quality v/s quantity, Errors, Data collection methods, Attitudinal surveys, Questionnaire design and standardization, Study area and analysis zones, Sample size, Sampling units,frames and techniques.	07
4	**Trips:** Aggregate and disaggregate analysis, Definitions, Types of trips, Factors affecting trip generation, Methods of trip generation, Methods of trip distribution – Growth Factor methods, Synthetic methods, merits and demerits.	08
5	**Modal Analysis and Assignment:** Mode choice sets, Modal split models – First and second generation, Stochastic models, Choice theories, Discrete choice analysis, Logit models, Model specification, estimation and validation; Network analysis, Route or tree building algorithms, Network assignments methods.	08
6	**Sustainable Transportation:** Issues and Guidelines of sustainable transportation, Planning for Mass Transit systems, Planning for Non-Motorized vehicles.	06
	Total	**42**

11. SuggestedBooks:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1	B. G. Hutchinson, "Principles of Urban Transport Systems Planning" Scripta Book Co., Washington	1974
2	Anthony J. Richardson, Elizabeth S. Ampt and Arnim H. Meyburg, "Survey Methods for Transport Planning" Eucalyptus Press, Australia.	1995
3	Roy Thomas, "Traffic Assignment Techniques", Avebury Technical, Aldershot, England	1991
4	C A O'Flaherty, ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

6. Subject Code : **CEN-665** Course Title : **Road Traffic Safety**

7. Contact Hours : **L: 3 T : 1 P: 0**

8. Examination Duration(Hrs): **Theory 3 Practical 0**

9. Relative Weight : **CWS: 20-35 PRS: 0 MTE:20-30 ETE: 40-50 PRE: 0**

10. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PEC**

12. Pre-requisite: Nil

13.Objective: To introduce the concepts of traffic safety on highways and to make students familiar with related analytical methods and remedial measures.

14. Details of course:

S. No.	Contents	Contact Hours
01	Introduction: Road traffic accidents scenario in India, characteristics of accidents, accident vs. crash, effect of human factors, planning for road network, land use and road environmentforsafety,designingforroadsafety–linksandjunctions,roadsafety engineering, road safety improvement strategies, elements of a road safety plan.	06
02	Crash investigation and analysis: Steps in treatment of crash locations, diagnosing crash problem and solutions, accident report form, storing of data, using and interpreting crash data, identifying and prioritizing hazardous locations, condition and collision diagrams; Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled; Crash reconstruction: understanding basic physics, calculation of speedfor various skid, friction, drag, and acceleration scenarios.	08
03	Statistical analysis of accidents: Descriptive statistics, confidence interval, hypothesis testing, models related to accident frequency, accident severity, accident duration, various methodological issues – over/under dispersion, time-varying explanatory variables, unobserved heterogeneity, endogeneity, under-reporting, spatial and temporal correlation, etc; Accident prediction model.	08
04	Before -after methods in crash analysis: Before and after study, before and after study with control sites, comparative parallel study, before, during and after study, Empirical Bayes method.	04
05	Economic analysis of accidents: Accident costing-economic appraisal, EUAC, PWOC, B/C ratio, IRR, NPV.	04
06	Traffic management system: Traffic flow improvements, expressway patrol, public transit, ridesharing, mobility rest areas, park-and-ride lots, bus bays, signage, markings; ITS applications - vehicular navigation, crash avoidance system, incident management, traffic management centre, highwayside communication.	06
07	Road safety audits: Procedure, aims and objectives, roles and responsibility, history of road safety audit, design standards, tasks, various stages of safety audits; common identifiable problems, structuring of report, identifying common problems.	06
	Total	**42**

11. Suggested books

S. No.	Name of Authors/Books/Publishers	Yearof Publication/ Reprint
1	American Association of State Highway and Transportation Officials (AASHTO), "Highway Safety Manual", 1st Edition, AASHTO.	2010
2	Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, "Statistical and Econometric Methods for Transportation Data Analysis", 2nd Edition, Chapman &Hall/CRC Press,	2010
3	Ezra Hauer, "Observational Before -After Studies in Road Safety", Pergamon Press.	1997

4	Limpert, Rudolf. "Motor Vehicle Accident Reconstruction and Cause Analysis", 5th Edition, Lexas Publishing, Charlottesville, VA.	1999
5	Indian Roads Congress, "Highway Safety Code", IRC: SP-44:1996	1996
6	Indian Roads Congress, "Road Safety Audit Manual", IRC:SP-88-2010	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAMEOFDEPTT/CENTRE : **Department of Civil Engineering**

1. Subject Code: **CEN-666** Course Title : **Transport Economics**
2. Contact Hours : **L: 3** **T : 1** **P: 0**
3. Examination Duration(Hrs): **Theory 3** **Practical 0**
4. Relative Weight : **CWS: 20-35** **PRS: 0** **MTE:20-30** **ETE: 40-50** **PRE: 0**
5. Credits: **4** 6.Semester: **Spring** 7. Subject Area : **PEC**
8. Pre-requisite: Nil
9. Objective of Course: The course provides an outline of demand and supply side concepts and their application to transport policy and planning issues.

10. Details of the Course.

S. No.	Contents	Contact Hours
01	**Introduction and Overview: B**asic components of transport, economic development and urban development. Economic theory, transport as an economic activity, demand and supply issues in transportation sector, demand - supply equilibrium, cost and pricing of transport, law of diminishing returns, elasticity and consumer surplus, costs, pricing and subsidy policies, elements of engineering economics.	06
02	**Transportation Demand and Congestion:** Demand - Demand forecasting methods, factors influencing transport demand, direct and cross - price elasticity of demand, factors that cause shifts in demand function; Congestion - Main causes of traffic congestion, Mechanisms to deal with traffic congestion - congestion pricing, road space rationing, capacity expansion.	07
03	**Transport Supply and Regulation:** Supply - Supply of transport services, development of systems supply function; Regulation - Command and control type of regulation, fiscal measures such as road pricing and environmental taxation, safety and economic regulations in the context of transport services provided by public, issues of social, geographical and temporal equity.	06
04	**Transport Costs and Pricing:** Costs-Direct and external costs of transport, concept of generalized costs, social aspects of transport, joint and common costs of infrastructure, average and marginal cost principle, short-term and long-term costs of supply, congestion costs, external costs, Road User Cost and it's components; Pricing- Pricing principles, the marginal cost pricing rule, efficient pricing, cost complexities and cost recovery, peak-load pricing, second-best pricing, Transport subsidies, price discrimination.	10
05	**Appraisal and Evaluation of Transportation Projects:** Feasibility and evaluation, cost, impacts and performance levels, evaluation of alternatives, analysis techniques, cost-benefit analysis, social and financial benefits, Internal Rate of return method for economic and financial viability, valuation of time, measures of land value and consumer benefits from transportation projects, prioritization of projects, multi-criteria decision assessment.	08
06	**Funding and Financing of Transportation Projects:** Methods for raising funds for maintenance, improvement and expansion of transportation networks, taxation and user fee, financing through loans, bonds, PPPs and concessions.	05
	Total	**42**

11. SuggestedBooks:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1	Mccarthy, P.S., "Transportation Economics – Theory and Practice : A Case Study Approach", Blackwell Publishing.	2001
2	E. Quinet, R. Vickerman and R. W. Vickerman, "Principles of Transport Economics", Edward Elgar Publishing.	2004
3	Button, K. J., "Transportation Economics", 3rd Ed., Edward Elgar Publishing.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Civil Engineering

1. Subject Code: **CEN-667** Course Title: **Transportation Studies and Analysis Lab**
2. Contact Hours: **L:0** **T:0** **P:3**
3. Examination Duration (Hrs.): **Theory 0** **Practical 3**
4. Relative Weight: **CWS:0** **PRS:50** **MTE: 0** **ETE:0** **PRE: 50**
5. Credits: **2** 6. Semester: **Spring** 7. Subject Area: **PEC**
8. Pre-requisite: Nil
9. Objective : To make students conversant with the analysis and design using traffic and transportation planning data, either manually or using a dedicated software
10. Details of the Course:

S.N.	Contents	Contact Hours
	Observational Studies	**18**
1	Traffic Volume and Intersection/ Turning Movement Study	
2	Spot Speed, Travel Time and Delay Study	
3	Origin Destination Study and Household Survey	
4	Parking and Pedestrian Study	
5	Accident and Traffic Noise Study	
	Software Based Analysis	**24**
6	Alignment and Profile Design	
7	Four-Step Travel Demand Estimation	
8	Video-metric Volume and Speed Analysis	
9	Logit Analysis and Modelling	
	Total	**42**

11. SuggestedBooks

S.N	Name of Authors/Books/Publishers	Year of Publication
1.	Roger P Roess, Elena S Prassas, William R McShane, "Traffic Engineering" 4th Ed, Prentice Hall.	2011
2.	May, A.D., "Fundamentals of Traffic Flow", Prentice Hall, Inc. 2nd Ed.	1990
3.	C JotinKhisty and B Kent Lall, 'Transportation Engineering – An Introduction", Prentice Hall India	2006
4.	Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.	2008
5.	Relevant software available in IIT Roorkee	

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Dept.: **Department of Civil Engineering**

1. Subject code: **CEN-668** Course Title: **Multi-agent transport simulation framework**
2. Contact hours: **L: 0** **T: 0** **P: 3**
3. Examination duration (hrs): **Theory 0** **Practical 3**
4. Relative weight: **CWS: 0** **PRS: 50** **MTE: 0** **ETE: 0** **PRE - 50**
5. Credits: **2** 6. Semester: **Spring** 7. Subject area: **PEC**
8. Pre-requisite: Nil
9. Objectives of the course: To Introduce agent-based simulation and its applications regarding co-evolutionary algorithms, dynamic traffic assignment, transport economics and travel behavior analysis, and policy inferencing.
10. **Details of the course:**

S. No.	Contents	Contact hours
1	**Introduction to MAT Sim:** Writing first program, basics of Java; coordinate system, MAT Sim controller, inputs	6
2	**Input generation:** network generation, travel demand generation, facilities, behavioral parameters, GIS and importance in travel demand	8
3	**Network loading algorithm:** queue model, mixed traffic simulation, kinematic wave model, computational performance	6
4	**Transport economics:** utility function, user welfare and system welfare, dependency of choices on household income and other related attributes	7
5	**Re-planning:** choice dimensions (time choice, route choice, mode choice etc.) and their impact	7
6	**Analysis:** reading and analyzing events, generating plots using events, detailed analysis using other software packages	8
	Total	42

11. **Software:**
    a. **MAT Sim:** an open-source software
    b. **VIA:** a commercial product for visualization of software outputs
    c. **QGIS:** an open-source GIS software

12. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Stefania Bandini, Sara Manzoni, Giuseppe Vizzari, "Agent based modeling and Simulation"	2012
2	Klügl, Franziska, Bazzan, Ana, Ossowski, Sascha (Eds.), "Application of agent technology in Traffic and Transportation	2005
3	Andreas Horni, Kai Nagel, Kay W. Axhausen, "The multi-Agent Transport Simulation"	2016

Item No. 78.17: To consider the following proposals of Department of Hydro and Renewable Energy:

(a) Addition of "Instrumentation Engineering" as eligibility criteria for the admission in M. Tech. (AHES).

(b) Introduction of a new Open Elective Course (OEC) for B. Tech. students- (IAH-303 :Solar Photovoltaic Technology and Applications)

The IAPC in its 70th meeting held on April 02, 2019 recommended the proposal at Sl. No.(a). The IAPC also recommended the proposal at Sl. No.(b) with minor modifications **(Appendix-'A')**.

The above is submitted for the consideration and approval of the Senate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: ALTERNATE HYDRO ENERGY CENTRE

Appendix 'A'
Item No. Senate/78.17

1. Subject Code: **IAH-303** Course Title: **Solar Photovoltaic Technology and Applications**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage: **CWS: 20-35** **PRS: 0** **MTE: 20-30** **ETE: 40-50** **PRE: 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: To acquaint the UG students with various aspects of solar PV technology and its applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to photovoltaic technology; Scenario and status of solar photovoltaic technology in India and the World; Solar energy mission, policies and financing.	6
2.	Solar radiation – basic concepts, assessment and variability; Photovoltaic meteorology	7
3.	Fundamentals of semiconductors; Structure and working of solar cells; Characteristics and electrical models of solar cells.	7
4.	Overview of solar cell technologies: Silicon solar cell and Thin-film solar cell: Amorphous silicon, Thin polycrystalline silicon, Copper indium, Cadmium telluride.	5
5.	Components of solar PV system: photovoltaic generator; battery; power conditioning and control; Characteristics of solar modules and solar PV systems.	5
6.	Types of photovoltaic systems: grid-connected systems, stand-alone systems, hybrid systems.	6
7.	Design of stand-alone PV plants and grid-connected PV plants: phase, frequency matching and voltage conditioning, power transfer, operation of grid interaction inverter; protection, Operation and maintenance of Solar PV systems.	6
	TOTAL	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication
1.	Mertens, K., "Photovoltaics: Fundamentals, technology and practice", 1st edition, Wiley	2014
2.	Solanki, C. S., "Solar photovoltaics: Fundamentals, technologies and applications", 3rd edition, PHI Learning	2016
3.	Boxwell, M., "Solar Electricity Handbook – 2019 Edition", Greenstream Publishing	2019
4.	Waltz, C., "Photovoltaics: Engineering and Technology for Solar Power", Syrawood Publishing House	2017
5.	Kalogirou, S.A., "Solar Energy Engineering: Processes and Systems", Academic Press	2013
6.	Reddy, P. J., "Science and technology of photovoltaics", 2nd edition, CRC Press	2012

12. Suggested web references for policies: www.mnre.gov.in; websites of state renewable energy development authorities of various states of India

Item No 78.18: To consider and approve the recommendations of award committees for various awards.

(i) Nayyar Award for Excellence in Communication

First prize of Rs 50,000/- :

Mr. Siddharth Chaudhry MBA I Year (Enroll No. 18810073

Second Prize of Rs 30,000/- :

Ms. Tanya Ratra , B. Tech. Chemical Engg. (Enroll No. 16111034)

Third Prize of Rs 20,000/-:

Mr. Utkarsh Yadav, B.Tech. CSE (Enroll No. 16114069)

(ii) Manoj Jain Award for Human Values (Cash Prize of Rs. 50,000/- and a trophy) :Mr. Singh Rahulkumar Sunil, B.Tech. III Year MMED (Enroll No. 16118081)

(iii) BhagwanDevatma Award for Excellence in Social Service (Cash Prize of Rs. 20,000, and a medal) :Ms. Sakshi, B.Tech. III Year Chemical Engg. (Enroll No. 16112076)

(iv) Sh. Pandit Shiv Dayal Singh Memorial Award for Excellence in Social Service (Cash Prize of Rs. 20,000, and a medal) : Mr. Vishvendra Singh, Int. M.Tech. Geophysical Technology III Year (Enroll No. 16411032)

Item No 78.19: To consider and approve awardees for various non-convocation awards.

NAME OF Award/ SCHOLARSHIP	CRITERIA OF SCHOLARSHIP	NAME OF STUDENT	ENROLLMENT NO.	GENDER	C.G.P	BRANCH
Tara Chand Scholarship	Tara Chand Kanti Devi Cash Prizes of Rs. 2500/- to the student scoring highest C.G.P.A in B.Tech Civil 3rd Year	NAVNEET KUMAR	15113073	M	9.504	CE
Rai Bahadur Khushi Ram Sud& Smt. Durga Devi Sud Memorial Cash Prize	Rai Bahadur Khushi Ram Sud& Smt. Durga Devi Sud Memorial Cash Prize of Rs. 5000/- for obtaining highest CGPA in B.Tech. (Civil), II Year class	JATIN AGGARWAL	16113041	M	9.495	CE
Lt. Gen. Ram Adhar Loomba Cash Prize (GIRL)	Lt. Gen. Ram Adhar Loomba Cash Prize of Rs. 5000/- for the student who obtains highest CGPA in B.Tech. (Civil) III Year (among girl students)	KANCHAN SHRIVASTAVA	15113057	F	8.267	CE
Kaustubh Roy Memorial Cash Prize	Kaustubh Roy Memorial Cash Prize of Rs. 6000/- for obtaining highest CGPA up to B. Tech. Mech.Engg. III year	PULKIT SINGAL	15119040	M	9.897	ME
Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B.Tech. (CSE/E&C/Elect.) I Year	PURVI AGARWAL	17113096	F	9.511	EE
Rai Singh Jain Cash Prize	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B. Tech. (CSE/E&C/Elect.) II Year	DIVIYA	16115041	F	9.717	EE
Rai Singh Jain Cash Prize	Rai Singh Jain Cash Prize of Rs. 3000/- for the girl student obtaining highest CGPA in B.Tech. (CSE/E&C/Electrical) III Yr.	ANKITA SAXENA	15114011	F	9.326	CSE

Rai Singh Jain & Mrs. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Mrs. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech (CSE/E&C/Elect.) I Year	**GHETIA SIDDHARTH**	17114033	M	9.872	CSE
Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech.(CSE/E&C/Elect.)II Year.	**GAJARE PRANJAL MATHU**	16115043	M	9.848	EE
Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize	Rai Singh Jain & Smt. Shakuntla Devi Jain Cash Prize of Rs. 3000/- for the student (Male or Female) obtaining highest CGPA in B.Tech. (CSE/E&C/Elect.) III Year.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Prof. P. Mukhopadhyay Cash Prize	Prof. P. Mukhopadhyay Cash Prize of Rs. 2000/- for obtaining highest CGPA in B.Tech. (Elect.) III year.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Shri RaghurajBehariMathur Cash Prize (M)	Shri RaghurajBehariMathur Cash Prize of Rs. 20,000/- for a male student who has obtained highest CGPA amongst male students in B. Tech. Civil I year	**ADITYA HRIDAY UPADHYAY**	17113005	M	9.787	CE
Shri RaghurajBehariMathur Cash Prize (F)	Shri RaghurajBehariMathur Cash Prize of Rs. 20,000/- for a female student who has obtained highest CGPA amongst female students in B. Tech. Civil I year	**SAKSHI GUPTA**	17113105	F	8.787	CE

GauriShanker – Malti Prize	GauriShanker – Malti Prize of Rs. 10,000/- for the student who obtains highest CGPA in B.Tech. (Civil) III Year.	**NAVNEET KUMAR**	15113073	M	9.504	CE
Dr. G. Pande Gold Medal	For obtaining highest CGPA in M.Sc. (Previous) examination.	**SHARANYA SARKAR**	17610020	F	9.864	M.Sc Biotech.
Air CmdrShyam Chand Mehra	Air CmdrShyam Chand Mehra Scholarship" of Rs. 10,000/- to a girl student of B.Tech 1st year for obtaining highest CGPA in B.Tech. Electrical Engg.	**PURVI AGARWAL**	17113096	F	9.511	EE
Air CmdrShyam Chand Mehra	Air CmdrShyam Chand Mehra Scholarship" of Rs. 15,000/- to a girl student of B.Tech. 2nd year for obtaining highest CGPA in B.Tech. Electrical Engg.	**DIVIYA**	16115041	F	9.717	EE
Air CmdrShyam Chand Mehra	"Air CmdrShyam Chand Mehra Scholarship" of Rs. 10,000/- to a girl student of B.Tech. 3rd year for obtaining highest CGPA in B.Tech. Electrical Engg.	**AAYUSHI SHRIVASTAV A**	15115002	F	8.89	EE
EC-72 Batch" Cash Award	EC-72 Batch" Cash Award of Rs. 10,000/- for the student of 3rd year B.Tech. (E & CE) based upon performance of the student up to 2nd year.	**SIDHARTH THOMAS**	16112087	M	9.761	ECE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 1st year on the basis of Academics Performance of Autumn Semester .	**MOHIT KUMAR**	18114049	M	10	CSE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in	**SHUBHAM JOHRI**	17312025	M	9.956	MSM

	Engineering 2nd year on the basis of Academics Performance upto 1st year.					
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 3rd year on the basis of Academics Performance upto 2nd year.	**GAJARE PRANJAL MATHU**	16115043	M	9.848	EE
"1988 Batch Award" Cash Award	"1988 Batch Award" Cash Award of Rs. 12000/- to a student of all UG Programmes in Engineering 4th year on the basis of Academics Performance upto 3rd year.	**PULKIT SINGAL**	15119040	M	9.9	ME
Vinay K. and Sunita Jain Award	"Vinay K. and Sunita Jain Award" for Excellence in B.Tech. and IDD programmes in E & CE/CSE/Elect. Engg., related to Information and Communication Technologies (ICT) of Rs. 5,000/- for Fourth year male student on the basis of performance up to 3rd year. In case the recipient is receiving another award at the same time, the award should go to next performer.	**HRITURAJ SINGH**	15115060	M	9.9	EE
Vinay K. and Sunita Jain Award	"Vinay K. and Sunita Jain Award" for Excellence in B.Tech. and IDD programmes in E & CE/CSE/Elect. Engineering related to Information and Communication Technologies (ICT) of Rs. 5,000/- for Fourth year Female student on the basis of performance up to 3rd year. In case the	**ANKITA SAXENA**	15114011	F	9.326	CSE

	recipient is receiving another award at the same time, the award should go to next performer.					
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the First Cash Prize of Rs. 20000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 3rd year on the basis of weightage upto 75% having highest CGPA upto 2nd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME).	**JOSE ABY**	16117039	M	9.511	ME
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the Second Cash Prize of Rs. 10000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 3rd year on the basis of weightage upto 75% having highest CGPA upto 2nd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME).	**RiteshRanjan**	16117071	M	9.733	ME
Ajit Singh Yadav Memorial Proficiency Prize	Ajit Singh Yadav Memorial Proficiency Prize" the First Cash Prize of Rs. 25000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 4th year on the basis of weightage upto 75%	**PULKIT SINGAL**	15119040	M	9.9	ME

	having highest CGPA upto 3rd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis &Design (ME) and (4) Principles of Industrial Engineering (ME).					
Ajit Singh Yadav Memorial Proficiency Prize	"Ajit Singh Yadav Memorial Proficiency Prize" the Second Cash Prize of Rs. 15000/- to a student (Male/Female) of Mechanical & Industrial Engineering Deptt. 4th year on the basis of weightage upto 75% having highest CGPA upto 3rd year in MIED and 25% (1) Introduction to Environmental Studies (CE) (2) Ethics & Self Awareness(HSS) and (3) Engineering Analysis & Design (ME) and Principles of Industrial Engineering (ME)	**Anjanroop Singh**	15117010	M	9.35	ME
Ajit Singh Yadav Memorial Proficiency Prize	"Ajit Singh Yadav Memorial Essay Prize" for two best essays from all departments at IIT Roorkee. The topic for the essay shall be decided by the Institute for each year.	**Ist- SakshiPriya 2nd- SanskarChordiya**	Ist- 16111030 2nd- 17117075	Ist- Female 2nd- Male		Ist- Biotechnology 2nd- Mechanical
DwarkaDassBalwant Kaur Thapar Cash Prize	DwarkaDassBalwant Kaur Thapar" Cash Prize Rs. 6000/- to M.Tech. (AHES) Ist year student highest CGPA but not getting any other award of similar or higher amount.	**GautamNarula**	17512005	M	8.526	
Ashwani Kumar Goel, ALEO Manali Hydropower Award	'Ashwani Kumar Goel, ALEOManali Hydropower Award" of Rs. 10,000/- to a student having second highest CGPA among	**Ayush Jain**	17512003	M	9.158	AHES

	M.Tech. (AHES) I year students.					
Chattishgarh State Power Generation Corporation Hydro Awards	"Chattisgarh State Power Generation Corporation Hydro Awards" of Rs. 10,000/- p.a. to B.Tech. 3rd/ 4th Student for Securing Highest Marks in the Subject IAH-01 SHP Development for Autumn Semester	**Vivek Dhaka**	16113119	M	78	IAH
Mr. Harish Ms. VeenaMidha Cash Prize	Mr. Harish & Ms. VeenaMidha Cash Prize of Rs. 10,000/- to a student of M.B.A. (HRM) I Year Student.	**SahilJatele**		M	83.2	MBA
Balmar Lawrie Cash Prize	Balmar Lawrie Cash Prize of Rs. 10,000/- to Technology Management.	**SahilJatele**		M	80.5	MBA
Bihar Hydro Awards	Bihar Hydro Awards of Rs. 10,000/- to a student Securing Highest C.G.P.A. in M.Tech. I Year Student.	**Namgay Tenzin**	17512012	M	9.474	AHES
Excellence Award by 1972 batch	Excellence Award by 1972 batch of Chemical Engg. Scholarship Rs. 15,000/- for 2nd and 3rd Year (Innovative Mind, Total highest Marks, Business IQ, Sports)	**1. Shivani Singh 2. Pushkal Sharma**	1. 16112081 2. 15112065	1. F 2. M		Chemical
Om Prakash Gupta and Sushila Devi Memorial Scholarship	Om Prakash Gupta and Sushila Devi Memorial Scholarship of Rs. 10,000 to a girl student of B.Tech. I Year obtaining highest marks.	**DISHA BHATIA**	17112024	F	9.532	Chemical
Prof. B.S. Varshney Memorial Cash Prize	Prof. B.S. Varshney Memorial Cash Prize of Rs. 5,000 for Securing highest grades in the following two subjects: CH 206 Application of Th. CH 204 Transfer Process I (Heat Trans).	**SAKSHI**	16112076	F		CHEMICAL

Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs10,000/- to M.Tech. AHES I year – Securing highest CGPA in the I year and not awarded any other award of same or higher amount	Iqbal	17512008	M	9.474	AHES
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs 10,000/- M.Tech. EMRL I year – Securing highest CGPA in the I year and not awarded any other award of same or higher amount	YashveerJayra	17513010	M	8.611	EMRL
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs10,000/- M.Tech. AHES I year – Securing highest marks in the Seminar	Namgay Tenzin	17512012		92	AHES
Chhattisgarh State Power Generation Corporation Hydro Awards	Cash Prize of Rs 10,000/- M.Tech. EMRL I year – Securing highest marks in the Seminar	KetanSonkar	17513007		82	EMRL
Usha Annual Award	Cash Prize of Rs10,000/- M.Tech. AHES I year – Securing highest grade in Small Hydro Power Planning & Management Course	Namgay Tenzin	17512012		83	AHES

Item No.78.20: To consider and approve an award for Time Management.

Nayyar Award For Excellence in Time Management:

Mr. MohinderNayyar (IITR Alumnus, B.E. Mechanical, 1966) wishes to create a corpus to promote excellence among students in terms of effective time-management. The award would recognize and honour the ability of a student to carry out multiple activities simultaneously and show significant improvement in some of them without compromising on the others. The activities may be as diverse as possible including academic grade points, sports, cultural, hobbies, technical, leadership, social service, etc.

Eligibility

Student should have completed 2 years in IIT Roorkee.

Selection Process

(1) Interested students will submit a brief description on why they deserve this award.
(2) Applicant should mention SGPAs of all the previous semesters.
(3) Applicant should mention semester-wise involvement in various activities and demonstrate efficient management of time in multiple activities.
(4) Application must accompany supporting documents for the claims made.
(5) Applications will be reviewed and short listed by an award committee.
(6) The award committee will invite shortlisted applicants to make a presentation and will recommend up to five winners.

Number of awards: up to 5 awards @ Rs. 50,000/- per winner may be given in a year.

Item No. 78.21: To consider the requests of students regarding (A) continuation of program in spite of not fulfilling minimum SGPA, (B) semester withdrawal on medical ground, (C) extension beyond permissible limit and (D) 2nd mercy appeal.

Category A: Continuation of program inspite of not attaining minimum SGPA

1. Mr. Ashish Chakrawarty (Enr. No. 18537003), M.Tech. (HY), I Year.
2. Mr. Alvin Reddy (Enr. No. 18537020), M.Tech (HY), I Year.
3. Mr. Prakriti Sarkar (Enr. No. 18526009), M.Tech. (EQ), I Year.
4. Mr. Agni Bhattacharjee (Enr. No. 18525001), M.Tech. (EQ), I Year.
5. Mr. Anurag Meena (Enr. No. 18519002), M.Tech. (CE), IV Year.

The IAPC in its 69th meeting recommended the requests. The students have been provisionally allowed to register and attend the classes. Their registration is subject to recommendation of IAPC and approval of Senate.

Category B: Semester withdrawal on medical ground

1. Mr. Rohit Kumar (En.No. 18547012), M.Tech. (WRDM), I Year.

The student could not apply for semester withdrawal on account of medical grounds before the commencement of ETE. He, however, did not appear in any examination. He has now requested for semester withdrawal. The IAPC in its 69th meeting has recommended the request.

Category C: Extension beyond permissible limit

1. Ms. Parul (Enr.No. 11116034), B.Tech.(EC), IV Year.
2. Mr. Rakesh Kumar Meena (Enr.No. 10113084), B.Tech. (CE), IV Year.

The students listed in **Category-C** had earlier been granted extension beyond permissible limit. Their extension was valid only up to Autumn Semester 2018-19. Students could not complete their degree requirements citing medical reasons and have requested for further extension. The IAPC in its 69th meeting has opined that in spite of further extension, it would be difficult for the students to complete the credit requirement.

Category D: Continuation of studies in spite of name struck off

1. Ms. Mamta Meena (Enr. No. 14115069), B.Tech. (EE), IV Year
2. Mr. Jaikant Niwariya (16116024), B.Tech. (ECE) III Year
3. Mr. Nitish Kumar (16115079), B.Tech. (EE) III Year
4. Mr. Bhethala Sai Sujith(17119011), B.Tech.(MIED) I Year

In **Category-D,** the names of the students have been struck off due to non-fulfilment of minimum earned credit as per the decision taken in 76th meeting of the Senate. The students have requested for reconsideration through 2nd mercy appeal. The appeal of student at Sl. No.1 was considered by the IAPC in its 69th meeting and the appeals at Sl. Nos. 2 to 4 were considered in its 70th meeting. The resolutions of IAPC are as under:-

Appeal at Sl. No. 1-IAPC recommended that the student be allowed to continue studies on medical ground in view of new information provided by the student.

Appeal at Sl. No. 2 & 3- IAPC did not recommended the continuation of the student's program.

Appeal at Sl. No. 4 - IAPC recommended the request of the student.

The requests **(Appendix 'A')** are submitted for the consideration of the Senate.

Appendix 'A'
Item No. Senate/78.21

DETAILS OF STUDENTS' REQUESTS/ APPEALS

S. No	Name	Details	Recommendations	Supporting Documents
Category- A: Continuation of Program in spite of not fulfilling minimum SGPA				
1.	**Ashish Chakrawarty** M.Tech (HY) (Enr No 18537003)	-Health issue (Jaundice) -SGPA: 4.200 -Detained in 2 subjects due to shortage of attendance -Grades: B, C, C+	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	Medical documents verified by the CMO
2.	**Alvin Reddy** M.Tech (HY) (Enr No 18537020) (Foreign student- Fiji)	-SGPA: 4.200 -Failed in one subject -Grades: D, D+, D+, D+	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	N/A
3.	**Prakriti Sarkar** M.Tech. (EQ) (Enr. No. 18526009)	-SGPA: 4.211 -Failed in one subject - Grades: C+, D, D, D+	Department: recommended IAPC: recommended	N/A
4.	**Agni Bhattacharjee** M.Tech. (EQ) (Enr. No. 18525001)	-SGPA: 4.632 -Failed in one subject - Grades: C, D, C, C	Department: recommended IAPC: recommended	N/A
5.	**Anurag Meena** M.Tech. (CE) (Enr. No. 18519002)	-Health issue of mother -SGPA: 4.952 - Grades: D, D+, C	Department: recommended IAPC: recommended	Medical documents
Category-B: Semester withdrawal on medical ground				
1.	**Rohit Kumar** M.Tech (WRDM) (Enr No 18547012)	-Health issue (Surgery) -SGPA: 0.000 -Did not appear in any exam	Department: recommended Wellness Centre: not consulted by the student IAPC: recommended	Medical documents verified by the CMO

Category-C: Extension beyond permissible limit				
1.	**Parul** B.Tech (EC) (Enr No 11116034)	-Health issue (Sciatica) -CGPA: 4.986 -TEC: 147 -Balance Credits: 53 -SGPAs: 2.417, 2, 0, 2.714, 2.920, 2.667, 0.857, 3.367, 4, 1.35, 3.714, 3.304, 4.273, 4.286, 0 Credits earned in extension period : 0	Department: forwarded Wellness Centre: recommended IAPC: not recommended	-Medical documents
2.	**Rakesh Kumar Meena** B.Tech (CE) (Enr No 10113084)	-Health issue -CGPA: 4.867 -TEC: 147 -Balance Credits: 48 -SGPAs: 0.667, 2.643, 1.538, 0.571, 2.129, 4.385, 0.727, 2.667, 4.364, 2.526, 0.273, 0, 1.226, 2.030, 1.371, 0, 4.238, 0 Credits earned in extension period : 0	Department: recommended IAPC: not recommended	-Nil
Category- D: 2nd Mercy Appeal				
1.	**Mamta Meena** B.Tech (EE) (Enr No 14115069)	-Health issue -CGPA: 3.457 -TEC: 62 -Balance Credits: 106 -SGPAs: 6.048, 6.538, 0, 0, 0.462, 1.929	Department: recommended Wellness Centre: recommended IAPC: recommended	-Medical documents

2.	**Jaikant Niwariya** B.Tech (ECE) (Enr No 16116024) **(Request to Continue studies)**	- 2nd mercy appeal with new information regarding his father's health (heart attack) and poor financial condition - Health issue (Dengue & Hepatitis B) - Earlier his mercy appeal was not approved by Senate vide letter No. Acd./584/UG-15 dated Jan. 09, 2019	Department: forwarded Wellness Centre: recommended IAPC: not recommended	-Medical documents verified by the CMO
		-TEC till last Sem (Spring 17-18) - 44 - Min Required- 46 - CGPA- 2.786 - SGPA- 5, 3.250, 2.217, 0		
3.	**Nitish Kumar** B. Tech (EE) (Enr No. 16115079) **(Request to Continue studies)**	- 2nd Mercy appeal - Name Struck Off vide No. Acd./584/UG-15 dated Jan 09, 2019 on the decision of Senate (76th meeting) - Family problem - TEC till last Sem- 44 - Min Required- 46 - CGPA- 2.756 - SGPA- 4.762, 2.273, 1.913,0.571	Department: recommended Wellness Centre: recommended IAPC: not recommended	Medical document of family member

4.	**Bhethala Sai Sujith** **B Tech (PI)** (Enr No 17119011) **(Request to Continue studies and repeat 1st year)**	- 2nd Mercy appeal with new medical certificate for treatment for longer duration - Name Struck Off vide No. Acd./582/UG-15 dated Jan 09, 2019 on the decision of Senate (76th meeting) - Health Issue (internet traits/social disorder) - TEC till last Sem- 19 - Min Required- 22 - CGPA- 2.513 - SGPA- 2.571,2.444	Department: forwarded Wellness Centre: recommended IAPC: recommended	Medical document

Item No. 78.22: To consider the proposal for provision of admission of foreign nationals in M.Sc. programmes and eligibility criteria.

There is a provision of admission of international students to M. Tech. programme without any requirement of GATE score. However, there are no specific guidelines for the admission of foreign nationals to other masters' programmes. For the next academic session, applications for admission in M.Sc. programmes from foreign nationals through ICCR, Govt. of India have been received.

It is proposed that as per the existing norms for foreign nationals, the applications be sent to the respective academic departments/centres for review. Only those applications recommended by the departments/centres be considered for admission.

The IAPC in its 70th meeting held on April 02, 2019 recommended the proposal and in addition it also recommended that there should be a provision for admission of foreign nationals in all Masters' programmes with the exemption of the requirement of National Level Exams (GATE/JAM/CAT etc.) in line with the existing provision for M. Tech. admission and the seats to be supernumerary.

The above is submitted for the consideration and approval of the Senate.

Item No.78.23: To report adoption of MHRD notification regarding introduction of EWS category in admissions.

Implementation on the MHRD notification **(Appendix 'A')** in this regard has begun.

This is being reported to the Senate.

Appendix 'A'
Item No. Senate/78.23

सत्यमेव जयते

F No: 12-4/2019-U1
Government of India
Ministry of Human Resource Development
Department of Higher Education
*****

Shastri Bhawan, New Delhi
Dated: 17th January, 2019

OFFICE MEMORANDUM

Subject: Reservation for Economically Weaker Sections (EWSs) for admission in Central Educational Institutions.

In accordance with the provisions of the Constitution (One Hundred and Third Amendment) Act 2019, and the reference of Ministry of Social Justice and Empowerment vide OM No. 20013/01/2018-BC-II dated 17th January 2019, enabling provision of reservation for the Economically Weaker Sections (EWSs) who are not covered under the existing scheme of reservations for the Scheduled Castes, the Scheduled Tribes and the Socially and Educationally Backward Classes, it has been decided to provide reservation in admission to educational institutions subject to a maximum of ten per cent of the total seats in each category. This would not apply to the minority educational institutions referred to in clause (1) of Article 30 of the Constitution of India.

2. The provision of reservations to the Economically Weaker Sections shall be in accordance with the directions contained in the OM No. 20013/01/2018-BC-II dated 17th January 2019 of the Ministry of Social Justice & Empowerment and shall be subject to the following:

a) The reservations shall be provided to EWSs for admission in Central Educational Institutions, (as defined in clause (d) of section (2) of The Central Educational Institutions (Reservation in Admission) Act, 2006) from the academic year 2019-20 onwards.
b) The above reservation would not be applicable to the 8 institutions of excellence, research institutions, institutions of national & strategic importance as specified in the Schedule to The Central Educational Institutions (Reservation in Admission) Act, 2006, as amended from time to time, and appended to this OM, and to the minority educational institutions referred to in clause (1) of article 30 of the Constitution.
c) Every Central Educational Institution shall, with the prior approval of the appropriate authority (as defined in clause (c) of section 2 of The Central Educational Institutions (Reservation in Admission) Act, 2006), increase the number of seats over and above its annual permitted strength in each branch of

study or faculty so that the number of seats available, excluding those reserved for the persons belonging to the EWSs, is not less than the number of such seats available, in each category, for the academic session immediately preceding the date of the coming into force of this O.M.

d) Where, on a representation by any Central Educational Institution, the appropriate authority is satisfied that for reasons of financial, physical or academic limitations or in order to maintain the standards of education, the annual permitted strength in any branch of study or faculty of such institution cannot be increased for the academic session following the commencement of this Act, it may permit such institution to increase the annual permitted strength over a maximum period of two years beginning with the academic session following the commencement of this Act; and then, the extent of reservation for the Economically Weaker Sections shall be limited for that academic session in such manner that the number of seats made available to the Economically Weaker Sections for each academic session shall not reduce the number and the percentage of reservations provided for SC/ST/OBC categories.

e) The scheme for implementing the reservation for the EWS shall be displayed on the website of the institution as soon as possible, but no later than 31st March 2019.

3. The Chairman UGC, Chairman AICTE and Chairperson NCTE and the Bureau Heads of the Department of Higher Education in the Ministry of Human Resource Development responsible for management of the Institutions of National Importance are requested to ensure immediate compliance of this OM.

4. This issues with the approval of the Minister for Human Resource Development.

Encl: As above

12/1/19

(Smita Srivastava)
Director

1. **Chairman UGC**
2. **Chairman AICTE**
3. **Chairperson NCTE**
4. **All Bureau Heads of Department of Higher Education**

Copy to:

Chief Secretaries of all State Governments/UTs: with a request to give effect to the provisions of the Constitution (One Hundred and Third Amendment) Act, 2019 for all higher educational institutions funded/aided, directly or indirectly, by the State Government in such manner that the provision for reservation for EWS would become operational from the academic year 2019-20.

Appendix

SCHEDULE

(The Central Educational Institutions (Reservation in Admission) Act, 2006)

S.No.	Names of the Institutions of Excellence, etc.
1.	Homi Bhabha National Institute, Mumbai and its constituent units, namely:-
	(i) Bhabha Atomic Research Centre, Trombay;
	(ii) Indira Gandhi Centre for Atomic Research, Kalpakkam;
	(iii) Raja Ramanna Centre for Advanced Technology, Indore;
	(iv) Institute for Plasma Research, Gandhinagar;
	(v) Variable Energy Cyclotron Centre, Kolkata;
	(vi) Saha Institute of Nuclear Physics, Kolkata;
	(vii) Institute of Physics, Bhubaneshwar;
	(viii) Institute of Mathematical Sciences, Chennai;
	(ix) Harish-Chandra Research Institute, Allahabad;
	(x) Tata Memorial Centre, Mumbai.
2.	Tata Institute of Fundamental Research, Mumbai.
3.	North-Eastern Indira Gandhi Regional Institute of Health and Medical Science, Shillong.
4.	National Brain Research Centre, Manesar, Gurgaon.
5.	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.
6.	Physical Research Laboratory, Ahmedabad.
7.	Space Physics Laboratory, Thiruvananthapuram.
8.	Indian Institute of Remote Sensing, Dehradun.

Item No. 78.24: To report institution of new awards and scholarships.

(1) **Dr. Naresh Chandra Varshneya Scholarship:** Mr. Amit Varshney has created a corpus of Rs12,50,000 to honour and support two deserving students of Integrated M.Sc. Physics program @ Rs. 25,000 (Rupees Twenty Five Thousand only) per year to each student who are meritorious but financially constrained.

Besides the scholarship amount, certificates will also be given to the recipients. These scholarships will be given to first two students from the list of MCM awardee students of Integrated M.Sc. Physics.

(2) **Sh. Pandit Shiv Dayal Singh Memorial Award for Excellence in Social Service:** Lt Col. K.S. Dahiya has created a corpus of Rs 6,00,000/- for an award to honor an engineering student of third year for excellence in Social Service. The award carries a cash prize of Rs. 20,000/- (Rs. Twenty Thousand Only) along with a certificate and a medal.

The selection process would be based on inviting the application from the students at individual level who are actively involved in social service. These applications would be shortlisted by a committee consisting of two institute representatives and one donor representative. The shortlisted candidate will be asked to make a presentation in front of the above committee and the final recommendation will be sent to the Senate for the approval.

(3) **Smt. Santosh Rani Tandon Memorial Award** : Prof Mahesh C. Tandon has created a corpus of Rs 12,50,000/- for an annual award to honour a girl student of B.Tech. Civil Engineering Program who has secured the highest weighted grade point average among all girls in the compulsory courses of structural engineering up to 6th Semester of the program. The award would consist of a cash prize of Rs. 50,000/- (Rs. Fifty Thousand Only) and a certificate.

(4) **Umesh Bajaj Scholarship** :Mr. Umesh Bajaj has created a corpus of Rs 12,50,000/- to honour and support five deserving students @ Rs. 1 0,000 (Rupees Ten Thousand Only) per year to each student who are meritorious but financially constrained students of Electronics and Communications Department. Besides the scholarship amount certificates will also be given to the recipients. These Scholarships will be given to first five

students of B.Tech. II Year who will be getting MCM and are eligible to get only Rs. 10,000/- per year.

(5) **Harsh Wardhan Bhatnagar Award for Excellence in Leadership:** Shri Harsh Wardhan Bhatnagar has created a corpus of Rs12,50,000/- to recognise and honour the leadership skills of students who actively contribute in student campus groups at Bhavans, Department/Centre or Institute level. The award would be given to deserving UG student(s) who have exhibited leadership skills by making exemplary improvements in some recognized group. Two awards of Rs 25,000/- each will be awarded each year.

Eligibility:

1. Applications will be invited from the students who are associated with one or more student campus groups such as, Institute Alumni Relations Cell (IARC), IMG, NCC, EDC, Cultural Council, Technical Council, Hobbies Club, Sports Council, Bhawan Councils, SAC etc.

2. The applicant should be in the 8th Semester of his/her B. Tech./B.Arch. /Integrated M.Sc./IDD/Integrated M.Tech. programs admitted through JEE.

Selection Process:

1. Application should accompany documents about changes improvements by the applicant in the group. It should also accompany a handwritten article on "My Plans to excel in profession and life as a whole".

2. An award committee will invite shortlisted applicants to make a presentation and will recommend upto two winners.

3. Girl student will be given preference in case of a tie.

Chairman Senate has approved the above awards/scholarships.

This is being reported to the Senate.

Item No. 78.25: To report the inclusion of a new program elective course (PEC) MAN-528 "Simulation Techniques" in the Integrated M.Sc. (Applied Maths) & M.Sc. (Mathematics) programs.

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal to introduce new PEC and approved it **(Appendix 'A').**

This is being reported to the Senate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Appendix 'A'
Item No. Senate/78.25

NAME OF DEPTT. /CENTRE: **Mathematics Department**

1. Subject Code: **MAN-528** Course Title: **Simulation Techniques**
2. Contact Hours: **L: 3** **T: 0** **P: 2**
3. Examination Duration (Hrs): **Theory 3** **Practical 0**
4. Relative Weightage: **CWS 10-25 PRS 25 MTE 15-25 ETE 30-40 PRE 0**
5. Credits: **4** 6. Semester: **Autumn/Spring** 7. Subject Area: **PEC**
8. Pre-requisite: Knowledge of basic probability and statistics and any programming language
9. Objective: To impart knowledge of some simulation techniques with applications (particularly in finance)

10. Details of Course:

Sl.No.	Contents	Contact Hours
1.	Pseudo-random number generators, generator based on linear recurrences, add-with-carry and subtract-with-borrow generators, non-linear generators, theoretical tests for PRNGs based on recurrence modulo 2, statistical tests	3
2.	General sampling method, inverse transform method, acceptance-rejection method, composition, convolution and other useful identities, generating variates from standard distributions such as normal, gamma, exponential, beta, Poisson, binomial, normal random vector, Box-Muller method	11
3.	Variance reduction techniques, control variate method, antithetic variate method, importance sampling, stratified sampling, Latin hypercube sampling, moment-matching method, conditional Monte Carlo	12
4.	Quasi-Monte Carlo method, basic principles, lattices, digital nets and sequences, solo sequence, Faure sequence, Niederreiter sequence	10
5.	Application in finance, European option pricing under log normal model, randomised quasi-Monte Carlo American option pricing, estimating sensitivities and percentiles	6
	Total	42

11. Suggested Books:

S.No.	Name of the Authors/Books/Publishers	Year of Publication
1.	G. S. Fishman, "Monte Carlo: Concepts, Algorithms, and Applications", Springer	1996
2.	P. Glasserman, "Monte Carlo Methods in Financial Engineering", Springer	2003

3.	C. Lemieux, "Monte Carlo and Quasi-Monte Carlo Sampling", Springer	2009
4.	J. C. Hull, "Options, Futures and Other Derivatives", Prentice Hall	2002
5.	P. E. Kloeden and E. Platen, "Numerical Solution of Stochastic Differential Equations", Springer-Verlag	1992
6.	A. M. Law and W. D. Kelton, "Simulation Modeling and Analysis", McGraw-Hill, inc.	1991
7.	Sheldon Ross, "A First Course in Probability", Pearson	2013

Item No. 78.26: To report the inclusion of a new program elective course (PEC) EEN-614: Bio Medical Robotics.

The IAPC in its 70th meeting held on April 02, 2019 considered the proposal to introduce a new PEC and approved it with minor modifications **(Appendix 'A').**

This is being reported to the Senate.

INDIAN INSTITUTE OF TEHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EEN-614** Course Title: **Bio-Medical Robotics**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 1**

4. Relative Weight: **CWS: 10-25** **PRS: 25** **MTE: 15-25** **ETE: 30-40** **PRE: 0**

5. Credits: **4** 6. Semester: **Spring/Autumn** 7. Subject Area: **PEC**

8. Pre-requisite: **Bio-Medical Instrumentation, Introduction to Robotics, Control Systems Basics**

9. Objective:

To develop competence in designing, developing and controlling bio-medical robots and image guided techniques.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction to Bio-Medical Robotics** Introduction to application and paradigms of Bio-Medical Robots. Basic kinematics concepts – forward, inverse, spatial transformations, joints, degrees of freedom of biological systems. Tendon driven systems.	8
2.	**Minimally Invasive Surgery** Video images in MIS. Teleoperation. Augmented and Virtual Reality.	8
3.	**Image-Guided Interventions** Medical Imaging Modalities – CT, US, MRI. Needling System – Passive and Active Needles – Unicycle, Bicycle Modeling, Design concepts, Actuation involving smart actuator such as Shape Memory Alloy actuators, Image-Guided Feedback Control.	10
4.	**Rehabilitation Robotics** Exoskeletons-Design, Development and Control.	8

	Human Hand Biomechanics – Manipulability analysis, Redundancy resolution. EMG, EEG signal recording and processing using LabView.	
5.	**Current Topics in Bio-Medical Robotics** Haptic Augmentation in Exoskeletons. Robotic Catheters for percutaneous interventions. Unsupervised learning for mapping in Bio-Robots.	8
	Total	42

11. Laboratory Components:

S. No.	Experiments	Contact Hours
1.	Introduction to Laboratory Equipments – Exoskeletons, Ultrasound Imaging Modality and Electromagnetic Tracking System	2
2.	Simulation Study on Robot Dynamics	2
3.	Simulation Study on Robot Kinematics and Control	2
4.	Position Control of a Hand Exoskeleton using Subject's Intention.	2
5.	Force Control of a Hand Exoskeleton in Real-Time LabView Platform.	2
6.	Needle Maneuverability in Tissue Phantom through Image Guidance.	2
7.	Human Hand Biomechanics Study.	2
	Total	**14**

12. Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Paula Gomes, "Medical robotics: minimally invasive surgery", Woodhead Publishing.	2012
2.	Shane Xie, "Advanced Robotics for Medical Rehabilitation: Current state of the art and recent advances", Springer.	2016
3.	John J. Craig, "Introduction to Robotics Mechanics and Control", 3rd Ed., Pearson Prentice Education.	2005
4.	Mark W. Spong and M. Vidya Sagar, "Robotics Dynamics and Control", 2nd Ed., Wiley Education.	1989
5.	William R. Sherman and Alan B. Craig, "Understanding Virtual Reality, 1st Ed., Interface, Application and Design", Morgan Kaufmann Publication.	2003
6.	Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley and Sons Publication.	2000

Approved & forwarded.

5/4/2019

(DAPC Chairman)

Item No. 78.27: To report the approval on the request of the following student to extend his date of candidacy.

Sl. No	En. No.	Name	D.o.R.	Status	Deptt.	Due Date of Candidacy	Proposed Extension for Candidacy	Remarks	Decision
1.	17925010	Pankaj Singh Rawat	07.07.2017	Full-Time	Physics	06.01.2019	30.04.2019	Due to prolonged illness	Recommended by IRC

Looking at the urgency of the matter regarding continuation in Ph.D programme and on the recommendations of IRC, Chairman Senate has approved the request.

This is being reported to the Senate.

Item No. 78.28: To report adoption of MHRD Office Memorandum with respect to qualification for JRF/SRF and RA.

Implementation on the MHRD Office Memorandum **(Appendix 'A')** in this regard has begun.

This is being reported to the Senate.

F. No. 12-2/2018-U1
Government of India
Ministry of Human Resource Development
Department of Higher Education

Shastri Bhawan, New Delhi
Dated: 31st January, 2019

OFFICE MEMORANDUM

Subject: **Revision of emoluments and guidelines on service conditions for research personnel engaged in R&D programme of the Central Government Departments/ Agencies.**

The undersigned is directed to refer to OM No. SR/S9/Z-08/2018 dated 30th January 2019 of the Department of Science and Technology, Ministry of Science and Technology, on the subject cited above. The emoluments for research personnel engaged in R&D programmes funded by the MHRD shall be enhanced according to the following provisions:

1) **Emoluments:**

A. **Junior Research Fellow (JRF)/Senior Research Fellow (SRF)**

Sl. No.	Designation & Qualification	Existing Emoluments (per month)	Revised Emoluments (per month)
I	**Junior Research Fellow (JRF)** Post Graduate Degree in Basic Science OR Graduate / Post Graduate Degree in Professional Course selected through a process described through any one of the following: a. Scholars who are selected through National Eligibility Tests - UGC NET including lectureship (Assistant Professorship) and GATE. b. The selection process through National level examinations conducted by MHRD and its Agencies and Institutions such as UGC / IIT / IISc. / IISER / IIIT etc	Rs. 25,000/-	Rs. 31,000/-
II	**Senior Research Fellow (SRF)** Qualification prescribed for JRF with two years of research experience.	Rs. 28,000/-	Rs. 35,000/-

1

A.1 After completion of two years, an external assessment by the Institution where the student is enrolled for Ph.D is mandatory for upgradation from JRF to SRF. The fellow may be awarded SRF after successful assessment.

A.2 Annual Satisfactory Assessment is mandatory to continue the benefit of fellowship during SRF period.

B. Research Associate

Research associates may be fixed at a consolidated amount at one of the 3 pay levels given below depending upon the qualification and experience. The Institute/Organization concerned may decide the level in which a particular associate should be placed based on the experience. The Essential Qualification (EQ) for RA is as follows:

Ph.D/MD/MS/MDS or equivalent degree or having 3 years of research, teaching and design and development experience after MVSc/M.Pharm/ME/M.Tech with at least one research paper in Science Citation Indexed (SCI) journal.

Sl. No.	Category	Existing Emoluments (per month)	Revised Emoluments (per month)
I	Research Associate –I	Rs. 36,000/-	Rs. 47,000/-
II	Research Associate –II	Rs. 38,000/-	Rs. 49,000/-
III	Research Associate –III	Rs. 40,000/-	Rs. 54,000/-

2. **Service Conditions:**

(i) **DA:** JRFs, SRFs and Research Associates will not be entitled to DA.

(ii) **House Rent Allowance (HRA):** All research fellows may be provided hostel accommodation wherever available. Research fellowship holder residing in hostels shall not be entitled for HRA. Wherever provision of hostel accommodation is not possible, HRA may be allowed to all the above categories viz. JRF, SRF and RA as per Central Government norms applicable in the city/location where they are working. The percentage required for calculating HRA will be based on the fellowship amount.

(iii) **Medical Benefits:** The research fellows and research associates (JRF/SRF/RA) will be entitled for medical allowance as applicable in the implementing institution.

(iv) **Leave and other entitlements:** The JRF/SRF are eligible only for casual leave while Research Associates are entitled to leave as per rules of the host institution. Participation of any of these categories (JRF/SRF/RA) in scientific event/workshops held in India or abroad will be treated as "on duty" with due approval of the host institution. The travel entitlement for JRF/SRF/RA for participation in scientific events/workshops in India will continue to be the same as earlier i.e. 2nd AC by rail. Maternity leave as per the Govt. of India instructions issued from time to time would be available to female candidates in all categories.

(v) **Bonus & Leave Travel Concession:** JRFs, SRFs and Research Associates will <u>not</u> be entitled to these allowances.

(vi) **Retirement Benefits:** JRFs, SRFs and Research Associates will <u>not</u> be entitled to these benefits.

(vii) Publication/Patent: The results of JRF/SRF/RA's research work may be published preferably in standard refereed journals with the concurrence of the Fellow and his/her Supervisor / Advisor. It should be ensured by the fellow that the assistance provided by the funding agency of Government of India is acknowledged in all such publications.

(viii) Obligation of JRF/SRF/RA:

a) He/ She shall be governed by the disciplinary regulations of the host institute where he/she is working.
b) The JRF/SRF/RA must send a report of the research work done during the period of Fellowship as may be asked by the sponsoring agency.

3. The number of fellowships shall remain the same as is existing, unless modified with the approval of MHRD. The Departments / Agencies are requested to ensure that the above guidelines are followed in regard to the remuneration and other benefits to the research personnel engaged in R&D projects funded by them.

4. Selection for award of fellowship shall ordinarily be through common competitive examinations. However, for subjects where there is no examination presently, Government Departments and their authorized agencies and institutions may start conducting examinations to screen candidates for award of fellowships. This shall not be applied retrospectively and the persons already enrolled shall be exempted.

5. In order to further enhance value, quality and experience in doctoral research, the Government has agreed to incentivize the research output, for e.g. in the form of publications and patents. The proposals to incentivize research output will be considered separately and modalities for its implementation will be evolved.

6. **Date of Effect:** The revised emoluments will take effect from 01.01.2019. The requirement of funds should be worked out and the additionality should be met from the existing budget of 2018-19 through matching savings.

7. The Chairman UGC, Chairman AICTE and the Bureau Heads of the Department of Higher Education in the Ministry of Human Resource Development responsible for management of the Institutions of National Importance are requested to convey this to all the Institutions under their supervision immediately.

8. This issues with the approval of the Minister for Human Resource Development.

Encl: As above

31/1/19

(Smita Srivastava)
Director

1. **Chairman UGC**
2. **Chairman AICTE**
3. **All Bureau Heads of Department of Higher Education**