Report on Guidance for Competitive Examinations and Career Counselling offered by the Mathematics Department during July 2018 -2023

Mugberia Gangadhar Mahavidyalaya

The Department of Mathematics arranged various types of workshop and ICT based class for GATE/ NET/JAM/Competitive Examination during every academic year. In the departmental routine, the teachers are takeing the classess as per routine. Also many alumni are involving to the programme. Most of students are much more interest about the class and many student are qualifyed in NET/GATE/JAM/CAT/CTET/TET and others examinations. Several programme and activities are listed below:

Quiz Competition & Assessment Test
for
Career Counselling in Competitive Exams

Arranged By

Department of Mathematics

Mugberia Gangadhar Mahavidyalaya

Under DBT star college strengthening scheme, Govt. of India

prepared by…

Twameka Tripathi, Gouri Sankar Mandal

PG 4th Sem Students

under the supervision of …

Dr. Kalipada Maity

Associate Professor & HOD :: Dept of Mathematics

August 2022

Union Public Service Commission (UPSC) (https://www.upsc.gov.in/)

1) What is the full form of UPSC ?

a) **Union Public Service Commission** b) Union Public State Commission

c) United Public Service Commission d) none of these

2) Which recruitment commission conducts Civil Services Examination (CSE)?

a) **UPSC** b) RBI

c) SSC d) RRB

3) How many posts are there in UPSC-CSE ?

a) 23 b) **24**

c) 28 d) 40

4) What is the minimum educational qualification required for appearing in UPSC?

a) **Graduation** b) Masters

c) P.hD d) None of these

5) What is the upper age limit for the civil service exam (General category)?

a) **32**
b) 37
c) 35
d) 28

6) which type of organization UPSC is ?

a) **Constitutional Body**
b) Non statutory body
c) Non-Constitutional body
d) quasi-judicial body

7) Which service does not include in UPSC-CSE?

a) IAS
b) IPS
c) IRS
d) **Banking**

8) How many exams conducted by UPSC?

a) **10**
b) 9
c) 11
d) 5

9) When did the form fill-up process start for civil service?

a) **February**
b) March
c) January
d) April

**List of 24 services through UPSC-CSE

UPSC Posts – 3 Types of Civil Services

1. All India Civil Services
   1. Indian Administrative Service (IAS)
   2. Indian Police Service (IPS)
   3. Indian Forest Service (IFoS)
2. Group ‘A’ Civil Services
   1. Indian Foreign Service (IFS)
   2. Indian Audit and Accounts Service (IAAS)
   3. Indian Civil Accounts Service (ICAS)
   4. Indian Corporate Law Service (ICLS)
   5. Indian Defence Accounts Service (IDAS)
   6. Indian Defence Estates Service (IDES)
   7. Indian Information Service (IIS)
   8. Indian Ordnance Factories Service (IOFS)
   9. Indian Communication Finance Services (ICFS)
   10. Indian Postal Service (IPoS)
   11. Indian Railway Accounts Service (IRAS)
   12. Indian Railway Personnel Service (IRPS)
   13. Indian Railway Traffic Service (IRTS)
   14. Indian Revenue Service (IRS)
   15. Indian Trade Service (ITS)
   16. Railway Protection Force (RPF)
3. Group ‘B’ Civil Services
   1. Armed Forces Headquarters Civil Service
   2. DANICS
   3. DANIPS
   4. Pondicherry Civil Service
   5. Pondicherry Police Service

** 3 stage of UPSC-CSE exam

(1) Preliminary Exam (Objective Test)

(2) Main Exam (Written Test)

(3) Personality Test (Interview)

** Total Marks (prelims+mains+interview)

(200+1750+275)

= **200+2025**

Prelims

Paper	Marks	Time
Paper-1	200	2 Hours
Paper-2 (qualifying)(33%)	200	2 Hours

Mains

Paper	Name of the Paper	Nature of Paper	Marks	Time
Paper-A	Compulsory Indian Language	**QUALIFYING NATURE**	300	3 Hours
Paper-B	English		300	3 Hours
Paper-I	ESSAY	**MERIT RANKING NATURE**	250	3 Hours
Paper-II	General Studies I		250	3 Hours
Paper-III	General Studies II		250	3 Hours
Paper-IV	General Studies III		250	3 Hours
Paper-V	General Studies IV		250	3 Hours
Paper-VI	Optional Paper I		250	3 Hours
Paper-VII	Optional Paper II		250	3 Hours
Total			**1750**	

10) What is the full form of CAPF ?

a) **Central Armed Police Force**
b) Central Armed Public Force
c) Central Artificial Police Force
d) None of these

11) The CAPF examination is conducted to recruit Assistant Commandant(AC) which is a

a) Group C service
b) Group B service
c) **Group A service**
d) Group D service

12) The upper age limit of UPSC-CAPF AC exam is

a) 27 years
b) **25 years**
c) 28 years
d) 30 years

13) How many stages are there in UPSC CAPF AC exam ?

a) **3**
b) 2
c) 4
d) 1

14) When UPSC CAPF AC exam conducted ?

a) **August**
b) September
c) April
d) June

15) How many forces are there in CAPF ?

a) **7** b) 8

c) 5 d) 6

16) What is the full form of CDS ?

a) **Combined Defence Services** b) Central Defence System

c) Control Defence System d) None of these

17) Which advisory body conducts CDS exam?

a) **UPSC** b) Self organisation

c) IMA c) Indian navy

18) How many times the CDS exam conducted in a year ?

a) one b) **two**

c) three d) four

19) How many services are offered through CDS exam ?

a) 5 b) 3

c) **4** d) 2

CDS exam conducted for recruitment of Commissioned Officers in the **Indian Military Academy(IMA), **Officers Training Academy(OTA)**, **Indian Naval Academy (INA)**and **Indian Air Force Academy(IAF)**.

20) How many stages are there in UPSC CDS exam ?

a) **3**

b) **2 (written exam** and **SSB Interview)**

c) 4

d) 1

21) Does **Indian Forest Service** (**IFoS**) belong to All India service ?

a) **Yes**

b) No

22) Eligibility for CDS age limit (GS category)

a) **below 25 years**

b) above 25 years

c) max 22 years

d) 30 years

23) Which of the following service doesn't belong to All India services ?

a) IAS

b) IPS

c) **IRS**

d) IFoS

24) How many papers are there in UPSC-CSE prelims ?

a) **2**

b) 3

c) 1

d) 4

25) How many optional subjects are offered by UPSC?

a) 47

b) **48**

c) 45

d) 44

UPSC calendar for 2023

UNION PUBLIC SERVICE COMMISSION
PROGRAMME OF EXAMINATIONS/RECRUITMENT TESTS (RTs) -2023

Sl. No.	Name of Examination	Date of Notification	Last Date for receipt of Applications	Date of commencement of Exam	Duration of Exam
1.	**Reserved for UPSC RT/ Examination**			**15.01.2023 (SUNDAY)**	**1 DAY**
2.	Engineering Services (Preliminary) Examination, 2023	14.09.2022	04.10.2022	19.02.2023 **(SUNDAY)**	1 DAY
3.	Combined Geo-Scientist (Preliminary) Examination, 2023	21.09.2022	11.10.2022	19.02.2023 (SUNDAY)	1 DAY
4.	**Reserved for UPSC RT/ Examination**			**19.02.2023 (SUNDAY)**	**1 DAY**
5.	CBI (DSP) LDCE, 2023	30.11.2022	20.12.2022	11.03.2023 (SATURDAY)	2 DAYS
6.	CISF AC(EXE) LDCE-2023	30.11.2022	20.12.2022	12.03.2023 (SUNDAY)	1 DAY
7.	**Reserved for UPSC RT/ Examination**			**12.03.2023 (SUNDAY)**	**1 DAY**
8.	N.D.A. & N.A. Examination (I), 2023	21.12.2022	10.01.2023	16.04.2023 (SUNDAY)	1 DAY
9.	C.D.S. Examination (I), 2023				
10.	Civil Services (Preliminary) Examination, 2023	01.02.2023	21.02.2023	28.05.2023 (SUNDAY)	1 DAY
11.	Indian Forest Service (Preliminary) Examination, 2023 through CS(P) Examination 2023				
12.	I.E.S./I.S.S. Examination, 2023	19.04.2023	09.05.2023	23.06.2023 (FRIDAY)	3 DAYS
13.	Combined Geo-Scientist (Main) Examination, 2023			24.06.2023 (SATURDAY)	2 DAYS
14.	Engineering Services (Main) Examination, 2023			25.06.2023 (SUNDAY)	1 DAY
15.	**Reserved for UPSC RT/ Examination**			**02.07.2023 (SUNDAY)**	**1 DAY**
16.	Combined Medical Services Examination, 2023	19.04.2023	09.05.2023	16.07.2023 (SUNDAY)	1 DAY
17.	Central Armed Police Forces (ACs) Examination, 2023	26.04.2023	16.05.2023	06.08.2023 (SUNDAY)	1 DAY
18.	**Reserved for UPSC RT/ Examination**			**20.08.2023 (SUNDAY)**	**1 DAY**
19.	N.D.A. & N.A. Examination (II), 2023	17.05.2023	06.06.2023	03.09.2023 (SUNDAY)	1 DAY
20.	C.D.S. Examination (II), 2023				
21.	Civil Services (Main) Examination, 2023			15.09.2023 (Friday)	5 DAYS
22.	**Reserved for UPSC RT/ Examination**			**08.10.2023 (SUNDAY)**	**1 DAY**
23.	Indian Forest Service (Main) Examination, 2023			26.11.2023 (SUNDAY)	10 DAYS
24.	S.O./Steno (GD-B/GD-I) LDCE	13.09.2023	03.10.2023	09.12.2023 (SATURDAY)	2 DAYS
25.	**Reserved for UPSC RT/ Examination**			**17.12.2023 (SUNDAY)**	**1 DAY**

Note : The dates of notification, commencement and duration of Examinations/ RTs are liable to alteration, if the circumstances so warrant.

Staff Selection Commission

1) Staff Selection Commission - Combined Graduated Level Examination (SSC-CGL)

(https://ssc.nic.in/Portal/apply)

(https://ssc.nic.in/Portal/apply)

26) Which commission conducts SSC-CGL exam ?

a) **Staff Selection Commission**
b) School Service Commission
c) State Service Commission
d) None of these

27) Which type of officers are recruited in various posts in top ministries, departments and organizations of Government of India through SSC-CGL exam?

a) Group-A
b) **Group-B & Group-C**
c) Only Group-B
d) Group-D

28) The Staff Selection Commission was established in

a) 1978
b) **1975**
c) 1970
d) 1974

SSC CGL Educational Qualification

Post	Educational Qualification
Statistical Investigator-Grade B	Bachelor's Degree from any recognized University with a minimum of 60% in Mathematics in Class 12th OR Bachelor's Degree in any discipline with Statistics as one of the subjects in graduation
Assistant Audit Officer (Gazetted Post)*	Bachelor's Degree in any subject from a recognized University. OR CA/CS/MBA/Cost &Management Accountant/ Masters Commerce/Masters in Business Studies
Compiler	Bachelor's Degree from any recognized University or Institution And, Candidates must have studied either Economics/Statistics/Mathematics as a compulsory or as an elective subject.
Assistant Section Officer	Bachelor's Degree from a recognized University/Institute And, Candidates must also qualify in the Computer Proficiency Test
All other posts	Bachelor's Degree in any discipline from a recognized University or Institute

SSC CGL Age limit for various posts

SSC CGL Age limit	Post
18-30 years	Assistant, Inspector
18-30 years	Assistant Section Officer, Assistant, Auditor, Sub-Inspector, Junior Accountant, Tax Assistant, Assistant Account Officer, Upper Division Clerk
Up to 30 years	Sub Inspector, Assistant Enforcement Officer
Up to 32 years	Junior Statistical Investigator
Not exceeding 30 years	Assistant Audit Officer, Assistant Account Officer, Inspector of Central Excise, Assistant Enforcement Officer, Assistant Section Officer, Inspector of Income Tax

29) The SSC CGL Exam is conducted in how many stages ?

a) 3 b) **4**

c) 2 c) 5

30) The age limit of SSC-CGL for different posts are in between

a) **18-32 years** b) 22-32 years

c) 25-30 years d) 18-30 years

SSC CGL Age limit to apply for various Departments is as follows

SSC CGL Age Limit	Department
20-30 years	Central Secretariat Service
Not exceeding 30 years	Intelligence Bureau
20-30 years	Ministry of Railway
20-30 years	Ministry of External Affairs
20-30 years	AFHQ
Not exceeding 30 years	CBDT
Up to 30 years	Directorate of Enforcement, Department of Revenue
20-30 years	Central Bureau of Investigation
Not exceeding 30 years	Officers under CAG
Up to 30 years	National Investigation Agency
Up to 32 years	M/O Statistics of Prog , & Implementation

SSC CGL Exam pattern

Tier	Subject	Number of Questions	Maximum Marks	Time allowed
Tier-I	General Intelligence and Reasoning	25	50	**60 Minutes (Total)** For VH/ OH (afflicted with Cerebral Palsy/ deformity in writing hand- PI **80 Minutes**
	General Awareness	25	50	
	Quantitative Aptitude	25	50	
	English Comprehension	25	50	
Tier-II	**Paper-I**: Quantitative Abilities	100	200	**120Minutes** For VH/ OH (afflicted with Cerebral Palsy/ deformity in writing hand- **160 Minutes**
	Paper-II: English Language and Comprehension	200	200	
	Paper-III: Statistics	100	200	
	Paper-IV: General Studies (Finance and Economics)	100	200	
Tier-III	Descriptive Paper in Hindi/English(Essay, Letter, applications, precis)	—	100	**60 Minutes** For VH/ OH (afflicted with Cerebral Palsy/ deformity in writing hand- **80 Minutes**

2) Staff Selection Commission Combined Higher Secondary Level (SSC CHSL)

(https://ssc.nic.in/)

(https://byjus.com/ssc-exams/ssc-chsl-eligibility/)

The exam is held to recruit the **Junior Secretariat Assistant (JSA), Lower Divisional Clerk (LDC)**, **Sorting Assistant (SA)**, **Data Entry Operator (Grade A & DEO)**.

Age limit - 18 to 27 years

Educational Qualification - 10+2 passed

Exam Pattern	**Subjects**	**Total Marks**	**Time (Mins)**
Tier – I	Quantitative Aptitude, English, General Awareness, General Intelligence	200	60
Tier – II	Letter/Application Writing, Essay Writing	100	120
Tier – III	Skill Test/ Speed Typing Test adjudged on the correct entry of data		

STAFF SELECTION COMMISSION

CALENDAR OF EXAMINATIONS FOR THE YEAR 2022-2023

Sl. No.	Name of Examination	Tier/Phase	Date of Advt.	Closing date	Month of Exam
1	Multi Tasking (Non-Technical) Staff, and Havaldar (CBIC & CBN) Examination-2021	Tier-I (CBE)*	22-03-2022	30-04-2022	Jul-2022
2	Selection Post Examination, Phase-X, 2022 and Selection Post Ladakh Examination, 2022	CBE*	12-05-2022	13-06-2022	Aug-2022
3	Recruitment of Head Constable (Ministerial) in Delhi Police Examination-2022	CBE*	17-05-2022	16-06-2022	Oct-2022
4	Recruitment of Constable (Driver) in Delhi Police Examination-2022	CBE*	08-07-2022	29-07-2022	Oct-2022
5	Recruitment of Head Constable (AWO/TPO) in Delhi Police Examination-2022	CBE*	08-07-2022	29-07-2022	Oct-2022
6	Junior Hindi Translator, Junior Translator and Senior Hindi Translator Examination, 2022	Paper-I (CBE)*	20-07-2022	04-08-2022	Oct-2022
7	Sub-Inspector in Delhi Police and Central Armed Police Forces Examination, 2022	Paper-I (CBE)*	10-08-2022	30-08-2022	Nov-2022
8	Junior Engineer (Civil, Mechanical, Electrical and Quantity Surveying & Contracts) Examination, 2022	Paper-I (CBE)*	12-08-2022	02-09-2022	Nov-2022

SSC CALENDAR OF EXAMINATIONS FOR THE YEAR 2022-2023

9	Stenographer Grade 'C' & 'D' Examination, 2022	CBE*	20-08-2022	05-09-2022	Nov-2022
10	Combined Graduate Level Examination, 2022	Tier-I (CBE)*	10-09-2022	01-10-2022	Dec-2022
11	Scientific Assistant in IMD Examination, 2022	CBE*	15-09-2022	03-10-2022	Dec-2022
12	Recruitment of MTS (Civilian) in Delhi Police Examination- 2022	CBE*	07-10-2022	31-10-2022	Jan-Feb, 2023
13	Combined Higher Secondary (10+2) Level Examination, 2022	Tier-I (CBE)*	05-11-2022	04-12-2022	Feb-Mar, 2023
14	Constables (GD) in Central Armed Police Forces (CAPFs), SSF and Rifleman (GD) in Assam Rifles Examination, 2022	CBE*	10-12-2022	19-01-2023	Mar-Apr, 2023
15	Multi Tasking (Non-Technical) Staff Examination, 2022	Tier-I (CBE)*	25-01-2023	24-02-2023	Apr-May, 2023
16	Recruitment of Constable (Executive) Male/Female in Delhi Police Examination, 2022	CBE*	02-03-2023	31-03-2023	Apr-May, 2023

*CBE- Computer Based Examination

Railway exams

Railway Recruitment Board (RRB)

(https://www.rrbcdg.gov.in/)

1) RRB Group-D (https://www.embibe.com/exams/rrb-group-d-eligibility/)
2) RRB ALP (Assistant Loco Pilot) (https://prepp.in/rrb-alp-exam/exam-pattern)
3) DFCCIL (Dedicated Freight Corridor Corporation of India Limited) (https://prepp.in/dfccil- executive-exam)
4) RRB ASM (Assistant Station Master) (https://testbook.com/rrb-asm/eligibility-criteria)
5) DRMC CRA (Delhi Metro Rail Corporation-Customer Relation Assistant) (https://testbook.com/dmrc-cra/eligibility-criteria)
6) RRB JE (Junior Engineer) (https://testbook.com/rrb-je/exam-pattern)
7) BIS (Bureau of Indian Standards) (https://prepp.in/bis-recruitment-exam)
8) ICAR (IARI) (Indian Council of Agricultural Research Indian Agricultural Research Institute Technician Exam) (https://prepp.in/icar-iari-exam)
9) RPF SI (Railway Protection Force-Sub Inspector) (https://prepp.in/rpf-si-exam)
10) RPSF (Railway Protection Special Force) (https://prepp.in/rpsf-recruitment-exam)
11) RRB NTPC(Non-Technical Popular Categories) (https://prepp.in/rrb-ntpc-exam/eligibility)
12) RRB Junior Stenographer (https://prepp.in/rrb-junior-stenographer-exam)
13) RRB Junior Translator (https://prepp.in/rrb-junior-translator-exam)
14) RPF Constable (https://prepp.in/rpf-constable-exam)

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
RRB Group-D	18-33 years	Cleared X th standard	Mathematics, General Science, Reasoning, GA/Current Affairs	100/100 questions	90
RRB ALP	18-30 years	Degree/ diploma in engineering (CE, ME, AE)	Logical reasoning, general intelligence, general awareness, current affairs, mathematics, general science and Engineering	**Stage 1-75** **Stage 2-175**	90 120
DFCCIL	18-30 years	Graduation/ Diploma in in engineering	General Knowledge, General Aptitude/Reasoning, Engineering	120	120
RRB ASM	18-32 Years	Graduation	Maths, General Intelligence & Reasoning, General Awareness on Current Affairs	100	90
DRMC CRA	18-30 years	Graduation	General Awareness, Quantitative Aptitude, General Reasoning General English	**Stage 1-120** **Stage 2-60**	90 45
RRB JE	18-33 years	Graduation/ Diploma in in engineering (CE, ME,EEE,AE)	**Math, General Intelligence and Reasoning, General Awareness & Science** **General Awareness ,Physics, Chemistry, Basics of Computer,EVS,PollutionControl, Technical Abilities**	**Stage 1-100** **Stage 2-150**	90 120

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
ICAR (IARI)	18-30 years	Graduation	General Knowledge, Mathematics, Science, Social Science	100	90
RPF SI	20-25 years	Graduation	General Awareness, Arithmetic Math, General Intelligence & reasoning	120	90
RPSF	18-25 years	passed SSC/10th (Constable) Graduation (SI)	Mathematics , General reasoning, General awareness	120	90
RRB- NTPC	18-33 years	12th Pass	Mathematics , GI & General reasoning, General awareness	120	90
RRB Junior Stenogr-apher	18-30 years	12th Pass	General Awareness, Hindi or English Language Typing – English - 80 wpm in 10 Mins Transcription Time- 50 Mins	100	90
RRB Junior Translator	18-33 years	Master's Degree	Mathematics, General Intelligence & Reasoning, General Awareness, General Science	100	90

Banking & Insurance Exams

1) **IBPS PO** (https://prepp.in/ibps-po-exam/eligibility)
2) **IBPS Clerk** (https://prepp.in/ibps-clerk-exam/eligibility)
3) **IBPS RRB** (https://prepp.in/ibps-rrb-exam/eligibility)
4) **SBI PO** (https://prepp.in/sbi-po-exam/eligibility)
5) **SBI Clerk** (https://prepp.in/sbi-clerk-exam/eligibility)
6) **IBPS SO** (https://prepp.in/ibps-so-exam/eligibility)
7) **NABARD Grade –A Exam** (**https://www.anujjindal.in/nabard-grade-a-complete-info/**)
8) **RBI Grade B Exam** (https://www.rbi.org.in/)
9) **SEBI Grade A Exam** (https://www.sebi.gov.in/)
10) **UPSC EPFO** (https://prepp.in/upsc-epfo-exam/eligibility)
11) **RBI Assistant** (https://prepp.in/rbi-assistant-recruitment-exam/eligibility)
12) **NIACL AO** (https://prepp.in/niacl-ao-exam)
    (https://www.newindia.co.in/portal/)
13) **IDBI Assistant Manager** (https://prepp.in/idbi-assistant-manager-exam)
14) **ESIC MTS** (https://prepp.in/esic-mts-exam)
15) **ESIC Stenographer** (https://prepp.in/esic-stenographer-exam)
16) **SIDBI Grade A** (https://www.adda247.com/jobs/sidbi-grade-a-recruitment/)
17) **Bank of Baroda PO** (https://prepp.in/bank-of-baroda-po-exam)

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
IBPS PO	20-30 years	Graduation	English , Quant, Reasoning English, DI, Banking & Economic Awareness, Reasoning & Computer Aptitude Interview & GD	100 200	60 180
IBPS Clerk	20-28 years	Graduation	English , Quant, Reasoning English, Banking & Economic Awareness, Reasoning ,Quant	100 200	60 160
IBPS RRB (Group A&B)	18-40 years For Scale I II,III,office Assistant	Graduation	Numerical Ability, Reasoning English/Hindi Language* General Awareness, Quant Reasoning & Computer Aptitude	80 200	45 120
SBI Clerk	20-28 years	Graduation & 50% in Class 10	English , Quant, Reasoning, Computer English, Banking & General Awareness, Reasoning & Computer Aptitude, Quant	100 200	60 160
SBI PO	22-30 years	Graduation	English , Quant, Reasoning English, DI, Banking & Economic Awareness, Reasoning & Descriptive English Group Discusssion Interview	100 250 20 30	60 210 - -
IBPS SO	20-30 years	Graduation	English ,Quant, Reasoning,Banking Awareness English, DI, Banking & Economic Awareness, Reasoning & Computer Aptitude	125 60	120 120

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
NABARD Grade –A & B	**21-30 years For grade-A** **25-32 years For grade-B**	60% marks in Graduation or Post Graduate degree 60% marks in Post Graduation	**Reasoning, English Language, Quant Computer, Decision Making, General awareness, Economic & Social Issues, Agriculture & Rural Development** **Paper 1: Descriptive English** **Paper 2: Economic & Social Issues, Agriculture & Rural Development** **Interview**	200 100 100 **50**	120 90 120 -
RBI Grade B Exam **(Max no. of attempt 6)**	**21-30 years Or 21-32/34 For M.phil/ P.hd**	**atleast 60% marks in Graduation** or **55% marks in Post Graduation**	**Quantitative Aptitude, Reasoning, English, and General Awareness** **Economic & Social Issues (ESI), Finance & Management (F&M), and English Descriptive papers** **Interview**	200 300	120 330
SEBI Grade A Exam	20-30 years	Master's Degree in in any discipline	**Phase 1-Paper 1: English, Quant, Reasoning , General Awareness** **Phase 2-Paper 2: English Descriptive** **Paper 2 for both Phase 1 and Phase 2** **Commerce, Accountancy, Management, Finance, Costing, Companies Act, and Economics** **Interview**	100 100 100 100 -	100 100 100 100 -

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
UPSC EPFO	21-27 years	Graduation	**General English, Indian Freedom Struggle, Current Events and Developmental Issues, Indian Polity & Economy, General Accounting Principles, Industrial Relations & Labour Laws, General Science & Knowledge of Computer applications, General Mental Ability & Quantitative Aptitude, Social Security in India** **Interview**	300	120
RBI Assistant	20-28 years	Graduation withat least 50% aggregate marks	**English, Reasoning ,Numerical Ability** **English, Reasoning ,Numerical Ability, General Awareness, Computer Knowledge** **Language Proficiency Test (LPT)**	100 200	60 135
NIACL AO	21-30 years	**Graduation/ Master's With at least 60% aggregate marks**	**Quant ,English Language, Reasoning, General Awareness** **Quant ,English Language, Reasoning, General Awareness**	100 200	100 150
IDBI Assistant Manager	21-28 years	Graduation withat least 55% aggregate marks	**English Language, Data Interpretation, Logical Reasoning, and Data analysis, Quantitative Aptitude, General Awareness/Economy/Banking** **Group Discussion** **Personal Interview**	200	120

Exam Name	Age Limit	Educational Qualification	Syllabus	Total Marks	Time (Mins)
ESIC MTS	18-25 years	Class 10th or equivalent degree	**General Intelligence and Reasoning** **General Awareness** **Quantitative Aptitude** **English Comprehension** ****same syllabus in prelims & Mains**	200 200	60 120
ESIC Stenographer	18-27 years	Passed 12th standard or equivalent degree	**English Language and comprehension, Reasoning ability, General Awareness** **Typing test in English/Hindi**	200 50	130 50/65
SIDBI Grade A		**Bachelor's Degree** in Engineering Or **PG** in any Subject	**Reasoning, English Language, Quantitative Aptitude, General & Banking/Finance Awareness** **Descriptive Test**	200 50	120 60
Bank of Baroda PO	20-28 years	Graduation or its equivalent Degree with Min 60% aggregate marks	**General/Economy/Banking Awareness, Reasoning and Computer Aptitude, Quantitative Aptitude, English Language** **English Language (Letter Writing & Essay)**	200 50	120 30

Banking & Insurance Exams

18) Canara Bank PO (https://prepp.in/canara-bank-po-exam)

19) EPFO Assistant (https://prepp.in/epfo-assistant-exam)

20) EPFO SSA (https://www.adda247.com/epfo-ssa-recruitment.html)

21) IDBI Assistant Manager (https://www.adda247.com/jobs/idbi-assistant-manager-recruitment-2022)

22) HARCO Bank Clerk (https://prepp.in/haryana-harco-bank-exam/eligibility)

23) J&K Bank PO (https://prepp.in/jk-bank-po-exam/eligibility)

24) Syndicate Bank PO (https://prepp.in/syndicate-bank-po-exam)

25) LIC HFL (https://prepp.in/lic-hfl-exam)

26) LIC Assistant (https://www.adda247.com/jobs/lic-assistant/)

27) LIC AAO (https://prepp.in/lic-aao-exam)

28) RBI Office Attendant (https://prepp.in/rbi-office-attendant-exam)

29) ESIC SSO (https://www.adda247.com/jobs/esic-sso-recruitmen)

33) IDBI Executive (https://prepp.in/idbi-executive-exam)

31) Punjab State Co-Operative (https://byjusexamprep.com/bank-exams/punjab-cooperative-bank-exam-eligibility-criteria)

32) ECGC PO (https://prepp.in/ecgc-po-exam)

33) LIC ADO (https://prepp.in/lic-ado-exam/eligibility)

34) RBI Security Guard (https://prepp.in/rbi-security-guard-exam)

35) NIACL Assistant (https://prepp.in/niacl-assistant-exam)

State Exams

1) UPSSSC JE Civil (https://prepp.in/upsssc-junior-engineer-exam)
2) UPSSSC JE Mechanical
(https://testbook.com/upsssc-junior-engineer/eligibility-criteria)
3) WBCS Executive (https://testbook.com/wbcs/eligibility-criteria) **
4) UPPCL JE Electrical (https://prepp.in/uppcl-je-exam)
5) West Bengal Police SI / Kolkata Police SI (https://testbook.com/wb-police-si/eligibility-criteria)/(https://testbook.com/kolkata-police-si/eligibility-criteria)

6) West Bengal Police Constable / Kolkata Police Constable
(https://testbook.com/wb-police-constable/eligibility-criteria)/
(https://testbook.com/kolkata-police-constable/eligibility-criteria)
7) West Bengal Executive Constable
(https://prepp.in/wb-excise-constable-exam/eligibility)
8) West Bengal Wireless Operator Police
(https://testbook.com/wb-police-wireless-operator)
9) Agragami in WBCEF & WWCD in Civil Defence
(https://www.adda247.com/jobs/wb-police-agragami-recruitment-2021/)

10) Wireless Supervisor (Technical) Grate II in WBP Telecommunication
(https://testbook.com/wb-police-wireless-supervisor)
11) Sub-Assistant Engineer (Civil) & Sub-Assistant Engineer (Electrical)
(https://testbook.com/wbphidcl-sub-assistant-engineer/eligibility-criteria)
12) WBNVF Agragami in Civil Defence (https://testbook.com/wb-police-agragami)

13) Delhi Forest Guard (https://testbook.com/delhi-forest-guard/eligibility)

14) West Bengal Group D (https://testbook.com/west-bengal-group-d)

15) WBSETCL JE Electrical (https://testbook.com/wbsetcl-je/eligibility-criteria)

16) Delhi Police Constable (https://prepp.in/delhi-police-exam/eligibility)

17) Delhi Police Head Constable (https://prepp.in/delhi-police-head-constable-exam)

18) CRPF SI (https://testbook.com/crpf-si)

19) WBPSC Food SI (https://testbook.com/wbpsc-food-si)

20) Jute Corporation of India (https://www.adda247.com/jobs/jute-corporation-of-india-recruitment/)

21) Technical Staff under Costal Security (https://www.indiajoining.com/coastal-security-police-west-bengal/)

22) WBPSE (https://wbpsc.gov.in/) **

West Bengal Civil Service (Executive) - W.B.C.S. (Exe.) Examinations

(https://wbpsc.gov.in/)

Public Service Commission
West Bengal

Qualification : Graduation

Age : Group (A&C) = 21 years , Group B = 20-36 years , Group D = 21-39 years

Preliminary Exam (Objective Type)

****The duration for the paper will be of 2.5 hours**

SL. No.	Compulsory Paper	Marks
1	English	25
2	General Science	25
3	Current Events	25
4	History of India	25
5	Indian Geography (Specially West Bengal)	25
6	Indian Polity & Economy	25
7	Indian National Movement	25
8	General Mental Ability	25
	Total	**200**

Mains Examinations (Descriptive & Objective Type)

****The duration for all the papers will be of 3 hours**

Paper	Subject (Compulsory Paper)	Marks
Paper -I	Regional Language(Bengali/Hindi/Urdu/Nepali/Santali)	200
Paper-II	**English:** Letter writing , Précis Writing	200
Paper-III	**General Studies - I :** (i) Indian History (ii) Geography of India	200
Paper-IV	**General Studies-II:** Science and Scientific & Technological advancement , Environment General Knowledge , Current Affairs	200
Paper-V	The Constitution of India and Indian Economy including role and functions of Reserve Bank of India	200
Paper-VI	Arithmetic & Test of Reasoning	200
	Total Marks	**1200**
Optional Subjects : Group A + Group B Subjects		**400**
Interview : **i) Group (A&B)=200 marks , ii) Group C = 150 marks , iii) Group D = 100 marks**		

All Defence Exams

1) **AFCAT** (https://prepp.in/afcat-exam/eligibility)
2) **CDS** (https://prepp.in/cds-exam/eligibility)
3) **NDA** (https://prepp.in/nda-exam/eligibility)
4) **Agniveer Navy** (https://www.adda247.com/defence-jobs/agniveer-navy-recruitment-2022/)
5) **Coast Guard Navik** (https://testbook.com/indian-coast-guard-navik-gd/eligibility)
6) **SSB** (https://prepp.in/ssb-recruitment-exam)
7) **Airforce Group X** (https://prepp.in/iaf-airmen-exam/eligibility)
8) **ICG Yantrik Electrical** (https://prepp.in/indian-coast-guard-yantrik-exam)
9) **ICG Yantrik Mechanical** (https://prepp.in/indian-coast-guard-yantrik-exam)
10) **Territorial Army** (https://prepp.in/territorial-army-exam)
11) **Agniveer Army GD** (https://www.adda247.com/defence-jobs/indian-army-agniveer-eligibility-criteria-2022/)
12) **BSF Constable** (https://testbook.com/bsf/eligibility-criteria)
13) **CISF Constable Fireman** (https://www.adda247.com/defence-jobs/cisf-fireman-constable-recruitment-2022/)
14) **Assam Rifles Technical** (https://www.adda247.com/defence-jobs/assam-rifles-recruitment-2022)
15) **BSF Radio operator** (https://prepp.in/bsf-ro-exam)
16) **Indian Army Soldier Clerk** (https://prepp.in/army-clerk-exam)
17) **Indian Army Soldier Technical** (https://prepp.in/indian-army-technical-exam)

18) Indian Army Soldier Tradesman (https://testbook.com/indian-army-soldier-tradesman/eligibility-criteria)

19) Indian Coast Guard Assistant Commandant (https://testbook.com/indian-coast-guard-assistant-commandant/eligibility)

20) SSB Head Constable (https://prepp.in/ssb-head-constable-exam)

21) AFCAT EKT Mechanical (https://testbook.com/afcat-ekt)

22) Air Force Group C (https://testbook.com/indian-air-force-group-c/eligibility-criteria)

23) Indian Army B.Sc Nursing (https://testbook.com/indian-army-bsc-nursing/eligibility-criteria)

24) ISRO Scientific Assistant (https://testbook.com/isro-scientific-assistant)

25) Army Cadet College (https://prepp.in/acc-exam/eligibility)

26) Army Havildar SAC (https://testbook.com/army-havildar-sac/eligibility-criteria)

Teaching Exams

1) UGC NET/JRF /SET (https://byjusexamprep.com/net-exams/wbset-exam-eligibility) (https://prepp.in/cbse-ugc-net-exam/eligibility)

2) CUET (https://testbook.com/cuet/eligibility-criteria)

3) NTA Delhi University (https://testbook.com/nta-du-non-teaching/eligibility-criteria)

4) CG TET (https://prepp.in/cgtet-exam)

5) WB TET (https://testbook.com/wb-tet/eligibility-criteria)

6) B.Ed Common Entrance (https://bihar-cetbed-lnmu.in/west-bengal-b-ed-admission)

7) NVS Multi Tasking Staff (https://testbook.com/nvs-mts/eligibility-criteria)

8) NVS Junior secretariat Assistant (https://testbook.com/nvs-junior-secretariat-assistant)

9) NVS Catering Assistant (https://testbook.com/nvs-catering-assistant)

10) WBSSC (https://prepp.in/wbssc-exam)

12) Central Teacher Eligibility Test (CTET) (https://ctet.nic.in/)

Nursing Recruitment

1) AIIMs Nursing Officers (https://prepp.in/aiims-nursing-officer-exam)

2) NVS Female Staff (https://testbook.com/nvs-staff-nurse/eligibility-criteria)

Civil Engineering & Mechanical

1) NCRTC Station Controller (https://prepp.in/ncrtc-station-controller-exam)
2) HPCL Civil Engineer (https://prepp.in/hpcl-engineer-exam)
3) NHPC JE Civil (https://prepp.in/nhpc-je-exam)
4) HAL Civil (https://testbook.com/hal/eligibility-criteria)
5) BPSC Assistant Sanitary (https://testbook.com/bpsc-asst-sanitary-waste-management-officer/eligibility-criteria)
6) UPSC ESE /IES Exam (https://www.careerindia.com/upsc/ies-exam-e26.html)
7) ISRO Scientist Civil (https://www.adda247.com/engineering-jobs/isro-exam-eligibility-criteria/)
8) CTL MT Civil (https://testbook.com/cil-mt-ce/eligibility-criteria)
9) DRDO Technician (https://prepp.in/drdo-technician-a-exam)
10) GATE (https://engineering.careers360.com/articles/gate-eligibility-criteria)
11) AAE ATC Junior Executive (https://prepp.in/aai-je-atc-exam)
12) ISRO Technician B (https://testbook.com/isro-technical-assistant/eligibility-criteria)
13) NTPC Diploma (https://prepp.in/ntpc-diploma-trainee-exam/eligibility)
14) BHEL Engineer (https://prepp.in/bhel-engineer-trainee-exam)

Electrical Engineer

1) BSF JE Electrical (https://www.nvsrobhopal.com/bsf-group-b-je-electrical-si-work-recruitment)
2) WBSETCL JE Electrical (https://testbook.com/wbsetcl-je/eligibility-criteria)
3) ISRO Scientist Electrical (https://testbook.com/isro-scientist-ee)

Miscellaneous (Other Engineering Fields)

1) BIS (https://prepp.in/bis-recruitment-exam)
2) JEE (https://engineering.careers360.com/articles/jee-main-eligibility-criteria)
3) ICAR (IARI) Assistant (https://www.adda247.com/jobs/iari-assistant-recruitment/)
4) ICAR Technician (https://prepp.in/icar-technician-recruitment-exam)
5) BARC DAE Junior (https://testbook.com/barc-dae/eligibility-criteria)
6) AAT ATC Junior (https://prepp.in/aai-je-atc-exam)
7) AAT JE (https://testbook.com/aai-je-airport-operations/eligibility-criteria)

ITI Exams

1) PSPCL ALM (https://testbook.com/pspcl-lineman/eligibility-criteria)
2) DRDO Technician (https://prepp.in/drdo-technician-a-exam)
3) ISRO Technician Electrical (https://testbook.com/isro-technical-assistant/eligibility-criteria)
4) ISRO Technician B (https://testbook.com/isro-technical-assistant/eligibility-criteria)
5) NFC-IGCAR Fitter (https://testbook.com/igcar-stipendiary-trainee/eligibility-criteria)
6) NMDC Maintenance Assistant (https://testbook.com/nmdc-maintenance-assistant/eligibility-criteria)
7) Northern Coalfields limited Recruitment (https://prepp.in/northern-coalfields-limited-exam/eligibility)

Miscellaneous

1) IB ACIO II (https://prepp.in/ib-acio-exam)

2) NBE Junior Assistant (https://testbook.com/nbe/eligibility-criteria)

3) ASRB AO (ICAR AO) (https://www.oliveboard.in/icar-ao/eligibility)

5) CSIR (https://www.csir.res.in/)

6) ICMR Assistant (https://prepp.in/icmr-assistant-exam)

7) India Post(GDS/BPM) (https://indiapostgdsonline.gov.in/)

8) NWDA LDC (https://prepp.in/nwda-recruitment-exam)

9) NPCIL Plant Operator (https://prepp.in/npcil-plant-operator-exam/eligibility)

10) NFC Chemical Plant Operator (https://testbook.com/nfc-chemical-plant-operator/eligibility-criteria)

11) RSMSSB JE (https://prepp.in/rsmssb-junior-engineer-exam/eligibility)

Master of Business Administration (MBA)

MBA is one of the most popular post-graduate courses in India and abroad .

Popular MBA entrance exams :-

1) **National-Level Test** conducted by an apex testing body or a top national B-school on behalf of the other participating colleges. Eg: **CAT, MAT, CMAT or ATMA.**

2) **State-Level Test** conducted by a state level testing body or a top state B-school on behalf of the other participating colleges in that state. Eg: **MAH-CET, OJEE, KMAT, TANCET or APICET.**

3) **Institute-Level Test** conducted for admission to its own MBA Programme. In some cases, these scores can be accepted as a qualifying criteria by other B-schools as well. Eg: **XAT, NMAT, SNAP, IBSAT.**

4) Test conducted by a university for admission to MBA Programmes being offered by colleges that are affiliated to it. Eg: **KIITEE, LUMET, HPU MAT.**

Common Admission Test (CAT) Exam

(https://iimcat.ac.in/)

**** The IIMs (Indian Institute of Management) conduct this Common Admission Test on a rotational basis.**

**** CAT Exam Fees : INR 1100 (Reserved categories)**

INR 2200 (Other categories)

** The **MBA fee generally ranges between INR 10-25 lakh** depending on college to college but **FMS Delhi** takes lower course fee such as approximately **Rs 10,480 per year**

**** Eligibility : Bachelor's degree with 50% aggregate(45% aggregate or equivalent for reserved categories)**

Time (Mins)	Syllabus	Total Questions	Total Marks
120 CBT mode	Verbal ability and Reading comprehension Data Interpretation and Logical reasoning Quantitative Ability	64-76	192-228

**** After qualify CAT exam on the basis of the Interview process candidates get selected into different IIMs**

****Personality assessment test round (Group Discussion or GD, Written Ability Test or WAT and Personal Interview or PI)**

TOP 20 IIMs

(https://en.wikipedia.org/wiki/Indian_Institutes_of_Management)

SL. NO.	Name	Course Offered	Duration
1	IIM Ahmedabad	PGP, PGPX/EPGP, FPM, AFP, PGP-FABM, ePGP, FDP	2y, 1y, 5y, 6 month, 2y, 2-3y,
2	IIM Bangalore	PGP, PGPX/ EPGP, FPM, PGPPM ,PGPEM	2y, 1y, 5y, 1y, 2y
3	IIM Calcutta	PGP, PGPEX, FPM, PGPEX-VLM, PGBDA, CEMS- MIM	2y, 1y, 5y, 1y, 2y, 1y
4	IIM Lucknow	PGP, FPM, EFPM, PGPABM, PGPSM, WPM, IPMX	2y, 5y, 4y, 2y, 2y, 3y, 1y
5	IIM Kozhikode	PGP, EPGP, PGPBL, FPM,	2y, 2y, 1y, 5y,
6	IIM Raipur	PGP, PGPWE, FPM, EFPM	2y, 1.5y, 5y, 4y
7	IIM Shillong	PGP, PGPEx-MBIC , FPM	2y, 14 months,5y
8	IIM Indore	PGP, EPGP, FPM, IPM, PGP-Mumbai, PGPMX, PGPHRM	2y, 1y, 5y, 5y, 2y, 2y, 2y

(https://www.shiksha.com/mba/articles/mba-courses-offered-by-iims-blogId-19127)

SL. NO	Name	Course Offered	Duration
9	IIM Ranchi	**PGDM, PGEPX, FPM, PGPEM, PGDHRM, CPGM**	**2y, 1y, 5y, 2y, 2y, 15 months**
10	IIM Rohtak	**PGPM, EPGP, FPM**	**2y, 1y, 5y**
11	IIM Kashipur	**PGP, EPGP, FPM, EFPM**	**2y, 1y, 5y, 4y**
12	IIM Tiruchirappalli	**PGPM, FPM, PGPBM**	**2y, 5y, 24 months**
13	IIM Udaipur	**PGP, PGPX, FPM, MDPWE**	**2y, 1y, 5y, 5 months**
14	IIM Amritsar	**PGP**	**2y**
15	IIM Bodh Gaya	**PGDM**	**2y**
16	IIM Nagpur	**PGP**	**2y**
17	IIM Sambalpur	**PGP**	**2y**
18	IIM Sirmaur	**PGPM**	**2y**
19	IIM Visakhapatnam	**PGP, PGCP-BMEP**	**2y, 15 months**
20	IIM Jammu	**PGP**	**2y**
21	** FMS Delhi	**MBA/PGDM, Executive MBA/PGDM, P.hD**	**2y, 2y, 5y**

COURSE NAME

1) Post Graduate Programme in Management (PGP)
2) Post Graduate Programme in Management for Executives (PGPX) / Executive Post Graduate Programme in Management (EPGP)
3) Fellow Programme in Management (FPM)
4) Armed Forces Programme in Business Management (AFP)
5) Post Graduate Programme in Food and Agri-business Management (PGP- FABM)

6) ePost Graduate Programme (ePGP)
7) Faculty Development Programme (FDP)
8) Post- Graduate Program in Public Policy and Management (PGPPM)
9) Post- Graduate Programme in Enterprise Management (PGPEM)
10) PGPEX-VLM (Post Graduate Program for Executives for Visionary Leadership in Manufacturing)

11) Post Graduate Diploma in Business Analytics (PGDBA)
12) CEMS MIM: Master's in International Management
13) Post Graduate Programme in Business Leadership (PGP-BL)
14) Post Graduate Diploma in Management (PGDM)
15) Post Graduate Programme in Management for Executives (PGEXP)

COURSE NAME

16) Post Graduate Diploma in Human Resource Management **(PGDHRM)**
17) Certificate Program in General Management **(CPGM)**
18) MDP for Women Entrepreneurs (MDPWE)
19) Post Graduate Programme in Management Mumbai **(PGP- Mumbai)**
20) Post Graduate Diploma Programme in Management for Executives **(Modular)- PGPMX- offered in Mumbai**

21) Post Graduate Programme in Human Resource Management **(PGP-HRM)**
22) Executive Fellow Programme in Management **(EFPM)**
23) Post Graduate Programme in Agri-business Management (PGP- ABM)
24) Post- Graduate Programme in Sustainable Management **(PGP- SM)**
25) Post-Graduate Programme in Management for Working Executives **(WPM)**

26) Management for Executives **(IPMX)**
27) Post Graduate Programme in Management for Working Executive **(PGPWE)**
28) Post Graduate Program for Executives - Managing Business in India and China (PGPEx- MBIC)
29) Post Graduate Programme in Business Management **(PGPBM)**
30) Post Graduate Certificate Programme in Business Management for Experienced Professionals **(PGCP-BMEP)**

Some Facts

1. There are 20 IIMs all run a PhD program.
2. CAT is not a mandatory requirement for a PhD from IIM.
3. IIMs can also award a PhD degree.
4. B.Tech & similar 4/5 year graduates are eligible.
5. CA, CS & even students from Integrated UG & PG programme can apply to IIM.
6. Students pursuing their qualifying degree can apply to the PhD programme of IIM.
7. Students from all and any stream can apply to the PhD Programme of IIM.
8. There is no fee for the full-time PhD Programme at IIM.
9. A monthly fellowship (stipend) is given to all Full-time PhD scholars.
10) Except CAT through some other exams like UGC-NET, CSIR-UGC NET, GATE students can apply for P.hD in various IIMs.

MBA Abroad

To pursue **MBA abroad**, candidates have to prepare for Graduate Management Aptitude Test (**GMAT**) and language proficiency tests Test of English as a Foreign Language **(TOEFL**) and International English Language Testing System (**IELTS**) for MBA abroad admission.

Academic qualification for MBA abroad is same as that of domestic programmes, i.e. 50 per cent aggregate in graduation or equivalent from a recognised university. Work experience of three to five years is required for most of the MBA courses abroad.

Quiz Competition & Assessment Test
for
Career Counselling in Higher Education

Arranged By

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Under DBT star college strengthening scheme, Govt. of India

Prepared by

Twameka Tripathi, Parthapratim Sahoo, Susmita Pahari ,
Sougata Bera, Sourav Bera,
Gouri Sankar Mandal, Ananya Pattanayak, Swarnendu Pradhan – PG 4th Sem Students

under the supervision of …

Dr. Kalipada Maity
Associate Professor & HOD :: Dept of Mathematics

August 2022

IISER(Indian Institutes of Science Education &Research)

1) How many IISERs are there in India?

a) 4 b) 6

c) **7** d)none of these

2) According to nirf ranking which IISER is best?

a) **IISER PUNE** b) IISER KOLKATA

c) IISER MOHALI d) IISER BHOPAL

3) Which IISER is good for Mathematics?

a) IISER KOLKATA b) IISER THIRUVANANTHAPURAM

c) **IISER MOHALI** d) IISER TIRUPATI

4) Which IISER is located in West Bengal ?

a) IISER PUNE b) **IISER KOLKATA**

c) IISER BHOPAL d) IISER MOHALI

5) IISER KOLKATA offers courses for students in math background

a) 5year BS-MS dual degree program

b) BS & MS program

c) Integrated PhD program

d) **All of these**

6) IISER KOLKATA application process started for Autumn semester

a) **April-May**

b) March-April

c) May-June

d) June-July

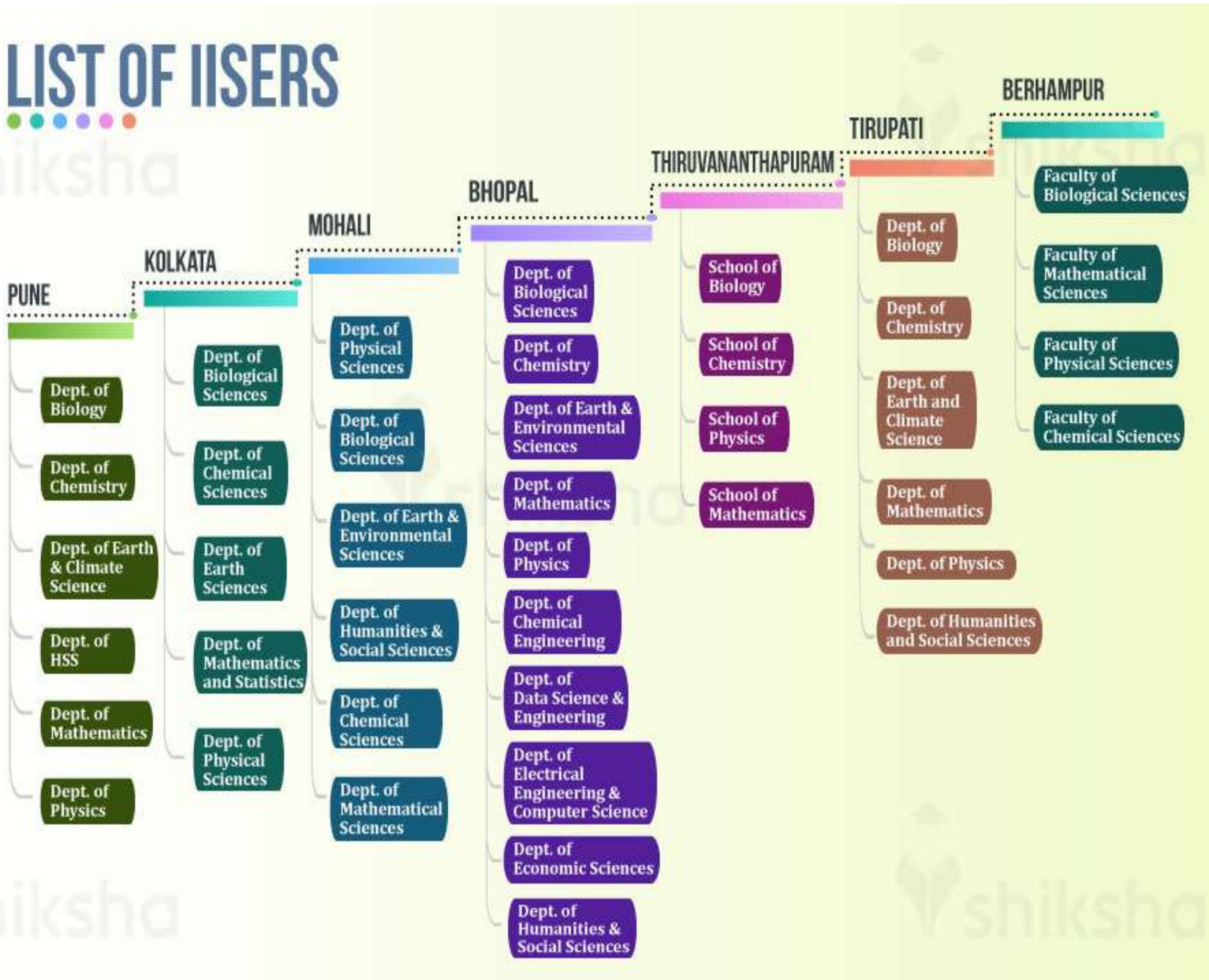
Admission Channels:-(A candidate can apply through any one or two or all the three channels)

1) Kishore Vaigyanik Protsahan Yojana (KVPY)
2) JEE-Advanced
3) State and Central Boards Channel (SCB)

All IISERs offer Mathematics in their BS-MS course

For more details go and check their website…

https://www.iiseradmission.in/


LIST OF IISERS
PUNE
Dept. of Biology
Dept. of Chemistry
Dept. of Earth & Climate Science
Dept. of HSS
Dept. of Mathematics
Dept. of Physics
KOLKATA
Dept. of Biological Sciences
Dept. of Chemical Sciences
Dept. of Earth Sciences
Dept. of Mathematics and Statistics
Dept. of Physical Sciences
MOHALI
Dept. of Physical Sciences
Dept. of Biological Sciences
Dept. of Earth & Environmental Sciences
Dept. of Humanities & Social Sciences
Dept. of Chemical Sciences
Dept. of Mathematical Sciences
BHOPAL
Dept. of Biological Sciences
Dept. of Chemistry
Dept. of Earth & Environmental Sciences
Dept. of Mathematics
Dept. of Physics
Dept. of Chemical Engineering
Dept. of Data Science & Engineering
Dept. of Electrical Engineering & Computer Science
Dept. of Economic Sciences
Dept. of Humanities & Social Sciences
THIRUVANANTHAPURAM
School of Biology
School of Chemistry
School of Physics
School of Mathematics
TIRUPATI
Dept. of Biology
Dept. of Chemistry
Dept. of Earth and Climate Science
Dept. of Mathematics
Dept. of Physics
Dept. of Humanities and Social Sciences
BERHAMPUR
Faculty of Biological Sciences
Faculty of Mathematical Sciences
Faculty of Physical Sciences
Faculty of Chemical Sciences

Indian Statistical Institute(ISI)

(https://www.isical.ac.in/)

7) How many ISI are there in India?

a) 5 c) 7

b)11 d) **6**

It has **four** subsidiary centres focused in academics at **Delhi, Bengaluru, Chennai and Tezpur,** and a branch at **Giridih** & **KOLKATA(HQ)**

8) ISI Kolkata conduct their entrance exam(masters) in which time?

a) **March-May** c) January- March

b) August-October d) April- June

9) Which ISI offers M.Math course after B.sc?

a) **ISI KOLKATA** c) ISI HYDERABAD

b) ISI MUMBAI d) ISI DELHI

10) After qualifying GATE exam one student get a chance to pursue

a) only P.HD c) only M.tech

b) **M.Tech or P.HD** d) none of these

11) ISI KOLKATA offers which courses for M.tech after M.sc math?

a) M Tech (CS) b) M Tech (CrS)

c) M Tech (QROR) d) **all of these**

12) Does ISI offer Junior/Senior Research Fellowship program?

a) **yes** b) No

13) Which ISI offers P.HD program in Mathematics ?

a) Kolkata b) Delhi

c) Bengaluru d) **All of these**

14) Who is the founder of ISI ?

a) **Prasanta Chandra Mahalanobis** b) Meghnad Saha

c) C.V. Raman d) Srinivasa Ramanujan

15) Does ISI have their own fellowship program for UG, PG students ?

a) **yes** b) No

- **For 1) B.Stat/B.math :- Rs. 5000/month ;**
  2) M.Stat/M.math/MS(QE)/MS(LIS)/MS(QMS):- Rs. 8000/month ;
  3) M.Tech(CS/QROR/CrS):- Rs. 12400/month

** **CrS:** Cryptology and Security **, QROR:** Quality, reliability and operations Research

Ramakrishna Mission Vivekananda Educational and Research Institute/ Vivekananda University (RKMVERI) (http://rkmvu.ac.in/)

16) RKMVERI(Belur) offers a two year MSc degree programe in *Big Data Analytics* (only for male) with

a) **at least 60% in B.SC** b) at least 70% in B.SC
c) at least 50% in B.SC d) at least 55% in B.SC

17) The syllabus for *Big Data Analytics* contains

a) Logical reasoning b) Quantitative Aptitude
b) Data Interpretation AND Data Visualization d) **all of these**

18) Admission process (RKMVERI) conducted in the time of

a) **april-june** b) January- March
c) August-october d) February-April

19) Which of the following courses are offered by RKMVERI ?

a) P.HD in Math b) M.SC in Computer Science
c) M.SC in Data Science d) **All of these**

CHENNAI MATHEMATICAL INSTITUTE

20) What is the full form of CMI ?

a) **Chennai Mathematical Institute**
b) Cell mediated immunity
c) Communication media information
d) Credit manager’s index

21) CMI was founded in

a) **1989**
b) 1990
c) 1987
d) none of these

22) CMI offers UG PG and PHD course in

a) Mathematics
b) Statistics
c) Computer Science
d) **all of these**

23) CMI was situated in

a) Cochin
b) Kolkata
c) **Chennai**
d) none of these

(https://www.cmi.ac.in/)

24) Who can apply for the course M.SC in Data Science in CMI ?
candidates having UG degree with background in

a) Mathematics
b) Statistics
c)Computer Science
d) **all of these**

25) Application process started in between

a) **March –May**
b)April –June
c) July-September
d) January –March

26) The CMI has invited PhD Mathematics candidates directly for interview who have qualified for the scholarship of

a) **NBHM**
b) CSIR
c) GATE
d) none of these

27) Does CMI offers campus placement ?

a) **yes**
b) no

Banaras Hindu University(BHU)

(https://www.bhu.ac.in/)

28) BHU conduct their M.SC admisssion through

a) JAM score

b) **conducting their own entrance(UET,PET)**

c) GATE score

d) none of these

29) Application process started in between

a) **April-July**

b) March –June

c) July-September

d) January –March

30) University in Varanasi located in

a) **Uttar Pradesh**

b) Bihar

c) Panjab

d) Haryana

31) Eligibility criteria for BHU M.SC entrance with UG percentile

a) 60%

b) 65%

c) 70%

d) **50%**

University of Hyderabad(HCU)

(http://acad.uohyd.ac.in/)

32) Candidates are eligible for admission in PhD course through

a) UGC-CSIR JRF b) NBHM

c) a)&b) both d) **a) or b)**

33) HCU offers offers M.Sc. courses in the stream of

a) Mathematics b) Applied Mathematics

c) Statistics-Operations research d) **all of these**

34) Each admitted student who do not possess any fellowship from any other agency will be paid a Fellowship/ Scholarship of Rs.

a) **1000/month** b) 6000/month

c) 1500/month d) 2000/month

35) The top two students get the **University Achievers awards** of Rs.

a) 1500/month b) **2000/month**

c) 6000/month d) 3000/month

36) For applying for the M.Sc Courses in HCU a candidate should have B.SC degree in Math/ Statistics with percentile

a) **55%** b) 60%

c) 50% d) 65%

37) HCU conduct their M.SC admisssion through

a) conducting written entrance test b) interview

c) **by both a) & b)** d) JAM score

38) Application process started in between

a) **May-July** b) March –June

c) July-September d) January –March

39) University of Hyderabad located in

a) **Telangana** b) Jharkhand

c) West Bengal d) Tamilnadu

40) Which of the following is not a central university?

a) Banaras Hindu University b) University of Hyderabad

c) Delhi University d) **ISI KOLKATA**

Harish-Chandra Research Institute (HRI) (http://www.hri.res.in/)

41) HRI located in

a) **Allahabad**
b) Hyderabad
c) Kolkata
d) Chennai

42) HRI is a premier institution dedicated to research (P.hD) in

a) Mathematics
b) Theoretical Physics
c) Chemistry
d) **a)&b) both**

43) In HRI the areas of focus in Mathematics are

a) Algebra,
b) Analysis
c) Geometry & Number Theory
d) **All of these**

44) In HRI online application for PhD commences in the month of

a) **July**
c) August
c) May
d) June

45) Candidates will be eligible to appear for the Admission Exam for the HRI Ph.D Programme through

a) NBHM scholarship
b) UGC-CSIR Fellowship (AIR 1-20)
c) Interview
d) **All of these**

46) The Institute (HRI) has recently started an M.Sc. Programme in

a) **Physics**
b) Mathematics
c) Chemistry
d) All of these

47) HRI offers SPIM(Summer program in Mathematics) in the month of

a) April-May
b) March-April
c) May-June
d) **June-July**

48) Candidates should apply for SPIM before

a) **May**
b) June
c) July
d) April

49) HRI was founded in

a) **1975**
b) 1976
c) 1974
d) 1977

Tata Institute of Fundamental Research(TIFR)

(https://www.tifr.res.in/)

50) TIFR was founded on

a) **1^{st} June 1945** b) 1^{st} June 1946

c) 1^{st} June 1947 d) 1^{st} June 1985

51) Who was the founder of TIFR with the help of whom ?

a) **Dr. Homi J. Bhabha & J.R.D Tata** b) Vikram Sarabhai

c) C.V Raman d) Satyendranath Bose

52) The School of Mathematics at TIFR Mumbai conducts research in Mathematics with emphasis on

a) **Pure mathematics** b) Applied mathematics

c) Geometry d) all of these

53) TIFR Mumbai is organizing a two-week summer school in mathematics named

a) **Vigyan Vidushi** (for women) b) Vigyan Mancha

c) Vigyan Shibir d) All of these

54) TIFR online application starts in

a) **October-November** b) June-July

c) March-April c) May-June

55) TIFR main campus is

a) **TIFR Mumbai** b) TIFR Hyderabad

c) CAM Bengaluru d) HBCSE Mumbai

**** Top institutes for higher studies in Mathematics**

1) IISC (https://iisc.ac.in/)
2) ISI KOLKATA (https://www.isical.ac.in/)
3) IISERs (https://www.iiseradmission.in/)
4) TIFR (They have their own fellowship program also)
(https://www.tifr.res.in/)
5) CMI (https://www.cmi.ac.in/)
6) IMSC (https://www.imsc.res.in/)
7) HRI (http://www.hri.res.in/)
8) NISER (https://www.niser.ac.in/)
9) IITs & NITs (Warangal & Trichy)

NATIONAL INSTITUTE OF SCIENCE EDUCATION AND RESEARCH BHUBANESWAR (NISER) (https://www.niser.ac.in/)

56) Online application starts in NISER in the month of

a) **April** b) May
c) March d) June

57) Candidates are eligible for P.hD with having marks in M.SC

a) **60%** b) 70%
c) 65% d) 80%

58) Candidates should have qualified for P.hD admission

a) CSIR-UGC-NET JRF b) GATE
c) NBHM d) **at least one of these**

59) NISER BHUBANESWAR offer courses on

a) Int. M.sc P.hD in Math b) M.sc in Math
c) P.hD in Math d) **both a) & c)**

The Institute of Mathematical Sciences(IMSC)

(https://www.imsc.res.in/)

60) IMSc provides exceptional intellectual environment for fundamental research in the areas of

a) Theoretical Physics `
b) Mathematics
c) Theoretical Computer Science & Computational Biology
d) **all of these**

61) IMSC application deadlines usually fall in

a) **Mid-February**
b) Mid-August
c) Mid-January
d) Mid-May

62) IMSC offers P.hD program to the candidates who have qualified

a) NBHM
b) GATE
c) NET
d) **any of those**

63) IMSC offers summer research program in in month of

a) **May-July**
b) July-September
c) April-June
d) June-August

Indian Institutes of Technology(IIT)

(https://www.iitsystem.ac.in/)

64) How many IITs are there in all over the India?

a) **23** b) 24
c) 20 d) 21

65) How to get an admission in P.hD Math in IIT ?
scoring good marks in

a) Csir NET-Jrf b) GATE
c) **any of the above or clearing the written test & interview conducted by individual IIT** d) NBHM

66) Which IIT is the oldest ?

a) **IIT Kharagpur** b) IIT Kanpur
c) IIT Madras d) IIT Delhi

67) How to get admission for M.SC in IITs?

a) **through JAM** b) through GATE
b) through NET d) through NBHM

68) IISC offers integrated P.hD program with eligibility

a) 60% marks in B.sc
b) Good score in JAM(MA)
c) any of those
d) **both a) & b)**

69) According to NIRF ranking which one is the top university ?

a) **IISC**
b) BHU
c) CMI
d) none of these

70) Among 1587 govt. institutions worldwide CSIR ranked

a) **37th**
b) 38th
c) 39th
d) 35th

71) CSIR ranked in ASIA

a) **7th**
b) 8th
c) 9th
d) 10th

72) For joining ISRO scientist –SC (entry level) basic qualification is

a) **M.SC**
b) B.SC
c) P.hD
d) none of these

73) Which ISI offers Bachelor’s degree ?

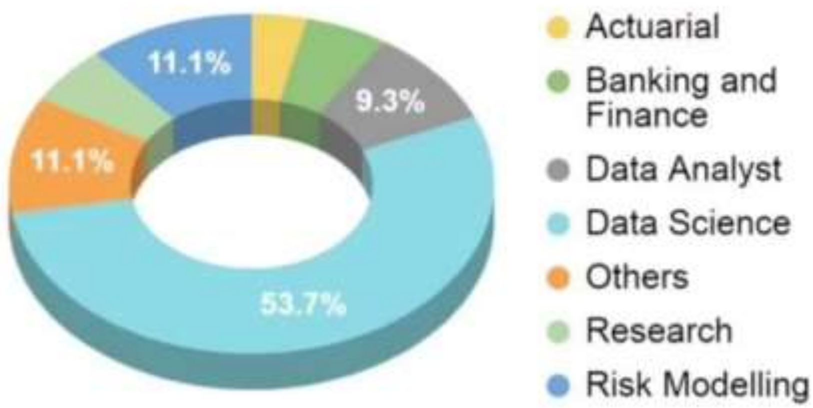
a) **ISI KOLKATA (B.Stat,B.Math)**
b) **ISI BANGALORE (B.Math)**
c) ISI CHENNAI
d) all of these

74) Where is ISI headquarter ?

a) **ISI KOLKATA**
b) ISI CHENNAI
c) ISI BANGALORE
d) ISI DELHI

Internship Statistics 2019-20

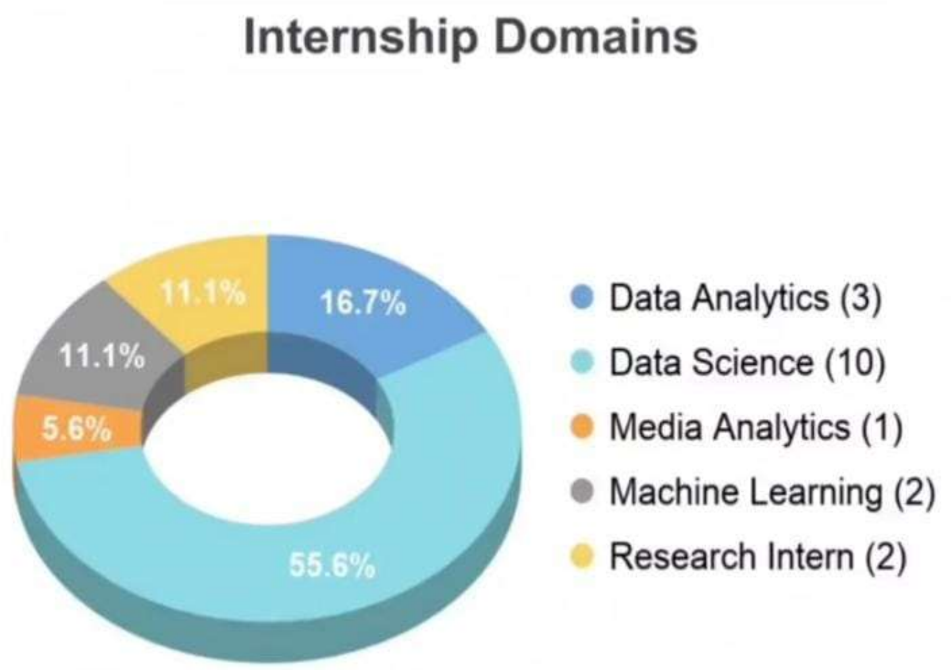
Internship Domains



Stipend	INR (Monthly)
Highest	1.2 lacs
Average	70 K
Median	65 K

Area of Expertise

- Machine Learning, Deep Learning & AI
- Natural Language Processing
- Computer Vision
- Image Recognition
- Pattern Recognition
- Data Mining
- Computational Finance
- Optimization
- Statistical Computation
- Quantum Learning Theory
- Advanced Algorithms
- Distributed Systems and Big Data
- Advanced Graph & Randomised Algorithms



*** List of Best Internship Websites in India**

1) Internshala
2) LinkedIn
3) Google Summer of Code(GSoC)
4) Google's Coding Competitions (Hash code , Code Jam, Kick-Start)
5) Chegg

*** Required coding Language**

1) Java
2) C, C++
3) Python

** Any two of those

75) Best NIT for MSc Mathematics

a) **NIT Warangal** b) **NIT Trichy**

c) NIT Rourkela d) NIT Surathkal

76) IISC situated in

a) **Bengaluru** b) Chennai

c) Tamil Nadu d) Kerala

77) NIT Warangal is best for

a) **Applied Mathematics** b) Pure Mathematics

c) Physics d) All of these

78) NIT Warangal offers course in **Mathematics and Scientific Computing** which is

a) **M.Sc course** b) B.sc Course

c) M.tech Course d) MS course

79) Some IITs offer M.tech course for M.sc Math students through gate are

a) IIT Kharagpur b) IIT Madras

b) IIT Guwahati d) **All of these**

80) Which IIT is good for Applied Mathematics ?

a) IIT Kanpur
b) IIT Delhi
b) **IIT Kharagpur**
d) IIT Bombay

81) Recently which IIT started a **3 years online B.sc** program in **Data Science** ?

a) **IIT Madras**
b) IIT Bombay
c) IIT Kharagpur
d) IIT Guwahati

82) Some Institutes dedicated only for Mathematics

a) ISI KOLKATA
b) CMI
c) IMSC
d) TIFR Mumbai
e) **All of these**

83) Which IIT offers **MSc-Ph.D dual degree** in **Operations Research** for math students

a) **IIT Bombay**
b) IIT Kharagpur
c) IIT Guwahati
d) All of these

84) Which IIT is best for Pure Mathematics ?

a) **IIT Kanpur**
b) IIT Delhi
b) IIT Kharagpur
d) IIT Bombay

85) **IISC** offers **integrated M.SC-P.hD** program for the candidates who qualify

a) **JAM**
b) GATE
c) NBHM
d) All of these

Some other institutes for their finest research program in Mathematics

1) **Institute of Mathematics & Applications, Bhubaneswar** (Integrated PhD& P.hD) **(https://iomaorissa.ac.in/admissions/)**

2) **Kerala School of Mathematics(offers** Integrated MSc-PhD & P.hD Program**) (**a center of excellence research in Mathematics**) (https://ksom.res.in/)**

3) **Indian Institute of Space Science and Technology (IIST),** Thiruvananthapuram, Kerala (P.hD in Mathematics) (https://www.iist.ac.in/)

4) **The Centre for Excellence in Basic Sciences (CEBS), Mumbai (** research in Mathematics **)**

(https://www.cbs.ac.in/research/research-mathematics)

5) **Birla Institute of Technology & Science, Pilani (BITS Pilani)** (Offers M.SC Math)

(https://www.bits-pilani.ac.in/hyderabad/mathematics/Courses)

6) **INSTITUTE OF CHEMICAL TECHNOLOGY (ICT), MUMBAI** (P.HD IN MATH)

(https://www.ictmumbai.edu.in/DepartmentHome.aspx?nDeptID=ca)

86) Who can apply in the summer research program

currently pursuing B.SC/M.SC degree in the 2^{nd} and 3^{rd} year / 1^{st} year of their course with a good CGPA .

87) Some good Math Internship in INDIA

a) At TIFR

b) SPIM at HRI

c) at CMI

d) IITs

e) IMSC

88) Full form of NBHM

National Board for Higher Mathematics (http://www.nbhm.dae.gov.in/node/38)

89) CSIR full form (https://www.csir.res.in/)

Council of Scientific & Industrial Research

90) GATE full form (https://gate.iitkgp.ac.in/)

Graduate Aptitude Test in Engineering

**** JAM : Joint Admission Test for M.SC** (organising institute IIT Guwahati for 2022)

(https://jam.iitr.ac.in/)

91) GATE exam conducted in a year for how many times ?

a) **one** b) two

c) three d) four

92) Form fill up started for GATE in which time ?

a) **Aug-Oct** b) Jan-Feb

c) April-June d) May-June

93) GATE exam conducted in the month of

a) **February** c) December

c) November d) January

94) Among the following options which exam is only for M.Sc?

a) **JAM** b) GATE

c) NET d) a)&b) both

95) Among the following options which exam is for Masters as well as P.hD?

a) JAM b) **GATE**

c) NET d) a)&b) both

96) Organising Institute for GATE 2023 is

a) **IIT Kanpur** c) IIT Delhi

c) IIT Bombay d) IIT Kharagpur

96) What is the full form of JAM?

a) **Joint Admission test for Masters**
b) Joint Application Manager
c)Joint account for Mutual funds
d) none

97) Form fill up started for JAM in which time ?

a) **Sep-Oct**
b) Jan-Feb
c) April-June
d) May-June

98) JAM exam conducted in the month of

a) **February**
c) December
c) November
d) January

99) Among the following options which exam is conducted twice in a year?

a) GATE
b) **NET**
c) JAM
d) JEE

100) NET exam conducted in the month of

a) **June & December**
c) January & July
c) May-November
d) April-October

101) Through which exam one get admission in P.hD?

a) NET
b) GATE
c) JAM
d) **a)&b) both**

102) In ISRO a Post Graduate Mathematics student join as

(a) Director

(b)***Scientists***

(c) Technician

(d) Designer

103) The recruitment procedure is

(a) Direct joining

(b) By recommendation

(c) ***Written test,interview***

(d) Merit based

104) In ONGC you can get a job as AEE (Reservoir) after qualifying

(a)***GATE***

(b) NET

(c) CAT

(d) NBHM

105) You can get MRFP fellowship from Indian Institute of Tropical Meteorology (IITM) Pune after qualifying

(a)***NET/GATE***

(b) SSC CGL

(c) RRB Exam

(d) UPSC

106) The duration of Fullbright scholarship is

(a) One year

(b) Two years

(c) ***Six to nine months***

(d) Five month

107) Which country gives DAAD scholarship for M.Sc and PhD program

(a) England (b)**Germany**

(c) America (d) India

108) The application Starts from

(a) **Aug-Oct** (b) Nov-Dec

(c) Jan-Feb (d) May-Jun

109) Google Ph.D fellowship is given for doing Ph.D in

(a) Analysis (b) Geometry

(b) **Mechine learning** (d) Algebra

110) One can get admission in MBA,PGP,PGDM courses by qualifying

(a) UPSC (b) JAM

(c) GATE (d)**CAT**

111) The CAT exam is conducted by

(a) ***IIM*** (b) IIT

(c) SSC (d) CSC

112) The minimum eligibility for CAT exam is

(a)***B.Sc*** (b) M.Sc

(c) 12^{th} (d) 10^{th}

113) The registration starts generally in

(a) January (b) March

(c) October (d) ***August***

114) It is conducted in a year

(a) Twice (b) Four times

(c) ***Once*** (d) Thrice

115) One can attempt this exam

(a) 2,times (b) ***Unlimited times***

(c) 4,times (d) 6,times

116) The validity of CAT scorecard is

(a) ***One year*** (b) Lifetime

(b) Two years (d) Five years

117) The form fill up of GATE exam starts from

(a)**Aug-Sept** (b)J an-Feb

(b) Nov-Dec (d) None of them

118) The exam Conducts in the month of

(a) Oct (b) Dec

(c) May (d) ***Feb***

119) The minimum eligibility of the exam is

(a)***B.Sc(Final year)*** (b) M.Sc

(c) 12thpass (d) 8thpass

120) Is there any age limit of this exam

(a) Yes (b) ***No***

121) The validity of GATE scorecard for admission in a instituion is

(a) ***Three years*** (b) Lifetime

(c) one year (d) none of these

122) It is conducted in a year

(a)Twice (b) Four times

(c)***Once*** (d)Thrice

123) The CSIR-NET is conducted in a year

(a)***Twice(Jun,Dec)*** (b) None of them

(c) Once(May) (d) thrice (May, June, July)

124) The application for NET-JUNE starts from

(a) April-May (b) ***Feb-March***

(c) Sep-Oct (d) Jun-July

125) The application for NET-DEC starts from

(a) April-May (b) Feb-March

(c) ***Sep-Oct*** (d) Jun-July

126) The minimum eligibility for this exam is

(a)B.Sc (b)12th

(c)10th (d)***M.Sc(Final year)***

127) The validity of NET-JRF scorecard is

(a) ***Two years***

(b) Four years

(c) Lifetime

(d) None of them

128) The validity of NET-LS scorecard is

(a) Two years

(b) Four years

(c) ***Lifetime***

(d) None of them

129) The application for M.Sc program through National Board for Higher Mathematics(NBHM) starts from generally

(a) August

(b) March

(c) December

(d) **July**

130) The application for Ph.D program through National Board for Higher Mathematics(NBHM) starts from generally

(a) August

(b) March

(c) ***December***

(d) July

131) Is there any age restriction of this exam

(a) Yes

(b) ***No***

132) The validity of NBHM scorecard for admission in a instituion is

(a) Two years
(b) Five years
(c) ***One year***
(d) Lifetime

133) The application for B.Sc, M.Sc,Ph.D program in Chennai Mathematical Institute(CMI) starts from generally

(a) August
(b)**March**
(c) December
(d)July

134) Aryabhatta Postdoctoral Fellowship: ARIES is given for

(a) P.hD degree holder
(b) M.sc degree hodegreeholder
(c) B.sc degree holder
(d)Madhyamic degree holder

135) Aryabhatta Postdoctoral Fellowship: ARIES Is given for

a) Only Mathematics students
(b) Only Engineer students
c)Both
(d) Others

136) Aryabhatta Postdoctoral Fellowship: ARIES Is given for the age of

(a) Not more than 35 years
(b) Not more than 42 years
(c) Not more than 52 years
(d) Not more than 52 years

137) IST-BRIDGE International Postdoctoral Program is given for

(**a)Ph.D degree or equivalent** (b) B.sc students only

(c) M.sc students only (d) H.sc Students only

138) IST-BRIDGE International Postdoctoral Program is given for

a)Mathematical and physical Sciences

b) Life Science

(c) Information and system science

(d) All of the above

139) ETH Zurich Research Grants: Doctoral Project: is given for

(a) P.hd students Only (b) M.sc students Only

(c) B.sc students Only (d) Madhyamik Student only

140) The website of ETH Zurich Research Grants: Doctoral Project; is

(a) www.ethgrants.ethz.ch

(b) www.ethgeantp.ethz.ch

(c) www.schorship.ethz.ch

(d) https://www.buddy4study.com/

141) ETH Zurich Research Grants: Doctoral Projects Duration time is

(a) **3 years(max)** (b) 5 years(max)

(c) 8 years(max) (d) 9 years(max)

142) The Level of ETH Zurich Research Grants: Doctoral Projects is

(a) P.hD degree only

(b) Master degree only

(c) Graduations students only

(d) H.sc students only

143) The deadline of ETH Zurich Research Grants: Doctoral Projects is

(a) March & September

(b)January and February

(c) March and April

(d) December and January

144) Postdoctoral Fellowship Program IIT-K is given by

(a) Indian Institute Of Technology Kanpur

(b) Indian Institute of Technology Madras

(c) Indian Institute of Technology Delhi

(d) Indian Institute of Technology Bombay

145) Fellowship level of Postdoctoral Fellowship Program IIT-K is

(a) Postdoctoral (b) Doctoral

(c) M.sc (d) B.sc

146) Which Country Provides Postdoctoral Fellowship Program IIT-K?

(a) India (b) Japan

(c) China (d) USA

147) Subject Area of Postdoctoral Fellowship Program IIT-K is

(a) Science & Engineering (b) History

(c) Geography (d) Others

148) Elligibility of Postdoctoral Fellowship Program IIT-K is

(a)**Ph.D degree with experience**

(b) M.sc degree with experience

(c) *B.sc* degree with experience

(d) Madhyamik degree with experience

149) Deadline of Postdoctoral Fellowship Program IIT-K is

(a) March-April (b) **Rolling Advertisement**

(c) January-February (d) November-December

150) 100 prime Minister’s doctoral Research Fellowships is given by

(a) Government of japan

(b) **<u>Government of india</u>**

(c)Government of usa

(d)Government of china

151) 100 prime Minister’s doctoral Research Fellowships is given to the student of

(a) Post Doctoral

(b) **<u>Doctoral</u>**

(c) Graduate

(d)Post Graduate

Science and Engineering Research Board (SERB)

Providing support to carry out research in emerging and frontier areas of science and engineering. Also provide financial assistance to persons engaged in such **research**, **academic institutions**, **research and development laboratories**, **industrial concerns** and **other agencies**.

152) Is SERB a Statutory Body ?

a) **Yes** b) No

153) SERB focuses in the area of promoting basic research in

a) **Science and Engineering** b) Arts

c) Economics d) none

154) SERB launched a scheme spacially promoting opportunities for womens called

a) **SERB-POWER** b) SERB-N-Pdf

c) **SERB Women Excellence Award** d) MATRICS

Note:- 1) "SERB Women Excellence Award" (eligibility)

a) age: below 40

b) only for women

c) Applicant must be having recognition from any one or more of the following national academies such as Young Scientist Medal, Young Associate etc.

d) Candidates have excelled in science and got recognition from any of the National Science Academies (given below) in India.

1) Indian National Science Academy, New Delhi
2) Indian Academy of Science, Bangalore
3) National Academy of Science, Allahabad
4) Indian National Academy of Engineering, New Delhi
5) National Academy of Medical Sciences, New Delhi
6) National Academy of Agricultural Sciences, New Delhi

e) Research grant of Rs. 5 lakhs per annum and Rs. 1 lakh per annum as overhead charges for a period of three years.

2) "SERB-POWER" (eligibility)

Two types of grant

Level I: The scale of funding up to **60 Lakhs for three years**. (for Applicants from IITs, IISERs, IISC, NITs, Central Universities, and national Labs of Central government Institutions)

Level II: The scale of funding up to **30 Lakhs for three years**. (for applicants from state Universities/ Colleges and Private Academic Institutions)

155) The mode of application in the SERB portal is

a) **online** b) Offline
c) Both d) any one

156) SERB launched schemes spacially for young researchers called

a) **SERB-N-Pdf** b) **Startup-research grant(SRG)**
c) SUPRA d) SERB-STAR

157) A scheme for Mathematical Research Impact Centric Support through SERB Called

a) SERB-POWER

b) SERB-N-Pdf

c) SRG

d) **MATRICS**

158) In **MATRICS** amount of Research grant is

a) **Rs. 2 lakh p.a. for a period of three years**

b) Rs. 5 lakh p.a. for a period of two years

c) Rs. 10 lakh p.a. for a period of three years

d) Rs. 4 lakh p.a. for a period of five years

159) The **Ramanujan Fellowship** is given to the brilliant Indian scientists and engineers who wants to come from

a) **Abroad to India & below 40years**

b) India to Abroad & below 40years

160) The **JC Bose fellowship** is awarded to active scientists

a) who are awarded by SS Bhatnagar prize and/or fellowship of science academies

b) which can be availed up to 68 years of age

c) normally twice a year periodically

d) **All statement are correct**

Shanti Swarup Bhatnagar Prize for Science and Technology (SS Bhatnagar prize)

1. The **Shanti Swarup Bhatnagar Prize for Science and Technology** (**SSB**) is a science award in India given annually by the Council of Scientific and Industrial Research (CSIR) for notable and outstanding research, applied or fundamental, in **biology**, **chemistry**, **environmental science**, **engineering**, **mathematics**, **medicine**, **and physics.**

2. The award is named after the founder Director of the Council of Scientific & Industrial Research, Shanti Swarup Bhatnagar & It was **first awarded in 1958**.
3. It is the most coveted award in **Multidisciplinary science** in India.

4. Any citizen of India engaged in research in any field of science and technology up to the age of 45 years is eligible for the prize & The prize is awarded on the basis of contributions made through work done in India only during the five years preceding the year of the prize.

5. The prize comprises **a citation**, **a plaque**, and **a cash** award of **₹5 lakh (US$6,300).** In addition, recipients also receive **Rs. 15,000 per month** up to the **age of 65 years**.

OTHER FUNDING OPPORTUNITIES through SERB

Schemes & Programs

- Intensification of Research in High Priority Areas (IRHPA)
- Start-up Research Grant (SRG)
- Core Research Grant
- Scientific and Useful Profound Research Advancement (SUPRA)
- Empowerment and Equity Opportunities for Excellence in Science
- Mathematical Research Impact Centric Support (MATRICS)
- Impacting Research Innovation and Technology (IMPRINT-2)
- International Travel Support
- Seminar/Symposia
- Short-term special call on COVID-19
- SERB-POWER Grant

Awards & Fellowships

- National Post Doctoral Fellowship
- J.C. Bose Fellowship
- Ramanujan Fellowship
- Teachers Association for Research Excellence (TARE)
- Visiting Advanced Joint Research Faculty (VAJRA)
- Overseas Visiting Doctoral Fellowship (OVDF)
- SERB Science and Technology Award for Research (SERB-STAR)
- SERB Women Excellence Award
- SERB-POWER Fellowship
- SERB Technology Translation Award (SERB-TETRA)
- National Science Chair

For more details go & check their website (https://www.serbonline.in/)

The Indian National Science Academy (INSA)

(https://www.insaindia.res.in/)

161) The main object of The Indian National Science Academy (INSA) is

a) promoting science in India
b) harnessing scientific knowledge
c) **a)&b) both**
d) neither a) nor b)

162) The Indian Journal of Pure and Applied Mathematics (**IJPAM**) is published by

a) **INSA**
b) INSPIRE
c) SERB
d) none of these

163) Another journal other than IJPAM published by INSA which is

a) **Indian Journal of History of Science (IJHS)**
b) Indian Journal of Mathematics and Science (IJMS)
c) Indian Journal of Science (IJS)
d) All of the above

164) The **National Institute of Sciences of India** was renamed as **Indian National Science Academy** in the year

a) **1970**
b) 1975
c) 1971
d) 1990

165) INSA JRD-TATA fellowship provides annually about 10 Fellowships to the young scientists, teachers and researchers for max 3 months below 45 years who possessing

a) Doctorate

b) M.sc/equivalent degree

c) B.sc

d) **a) & b) both**

166) The India Science and Research Fellowship (ISRF) is to provide opportunity to scientists and researchers from

a) **neighbouring countries to India**

b) India to neighbouring countries (Afghanistan, Bangladesh, Bhutan, Maldives, Myanmar, Nepal, Sri Lanka and Thailand)

167) The Prize **Indira Gandhi Prize for Popularization of Science** shall be awarded

a) **once in three years**

b) once in two years

c) twice in three years

d) twice in four years

168) The Prize **Indira Gandhi Prize for Popularization of Science** is given in the field of

a) **popularization of science in any Indian language, including English**

b) popularization of science in any Indian language, including Bengali

c) popularization of Mathematics

d) popularization of science

169) The prize money for the award of Indira Gandhi Prize for Popularization of Science is Rs.

a) **25,000/- , citation and a bronze medal**

b) 50,000/- , citation and a silver medal

c) 25,000/- , citation and a silver medal

d) 5,000/- , citation and a gold medal

170) **International Travel Support (ITS)** Scheme provides financial assistance to Indian researchers for presenting a research paper in an international scientific event held abroad with age group of

a) **below 35** b) below 40

c) below 30 d) below 25

171) The ITS scheme provides to & fro economic class air fare whose amount is

a) **Rs. 50,000/-** b) Rs. 70,000/-

c) Rs. 55,000/- d) Rs. 40,000/-

172) By the time of submission of application Applicant must have obtained from recognized institution

a) Master's degree in Science

b) Bachelor's degree in professional courses

c) an active Indian researcher engaged in R&D work

d) **All of the above**

173) Guidelines for Student Research and Travel Grant Applications (https://www.geneseo.edu/undergraduate_research/guidelines-student-research-and-travel-grant-applications)

a) Student MUST attend a Proposal Writing Workshop each academic year on a full time basis.

b) Student may apply twice a year and the year begins with the summer deadline.

c) A maximum of $600 will be awarded to each undergraduate recipient per semester or summer.

d) Groups of 3 or more students applying together for the same project will be given $1,500.

e) Projects must be supervised by a faculty mentor or sponsor and candidates must have a proper career goals.

174) Indira Gandhi Single Girl Child Scholarship offered financial assistance for two years of INR

a) 36,200 per annum b) 30,500 per annum

c) 60,000 per annum d) 36,500 per annum

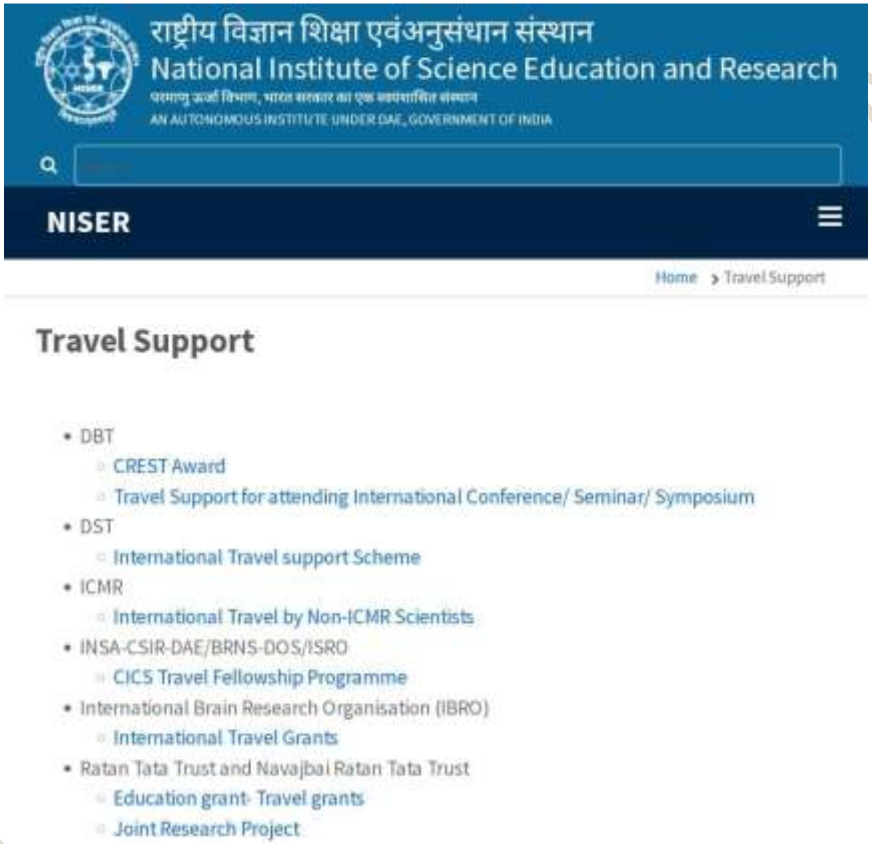
175) Indira Gandhi Single Girl Child Scholarship given only girls students pursuing

a) **PG course** b) UG course

c) B.ed d) All of these

NISER Travel Support

(https://www.niser.ac.in/content/travel-support)



Some others fellowship program for women

1) Women Scientist Scheme by DST
2) Women Scientist Scheme by DBT
3) Women in Science lectures by EMBO
4) Post Doctoral Fellowship for Women

DST Women Scientist Scheme (WOS-A)

(https://online-wosa.gov.in/wos/)

176) The Education Qualification for DST Women Scientist Scheme is

a) **M.sc/equivalent degree** b) Under graduation

c) diploma d) Any of these

177) Which organization awards women scientists by this schemes

a) **Department of Science and Technology**

b) Department of telecommunication

c) Department of women and child development

d) Department of health and family welfare

178) The age limit for DST Women Scientist Scheme is

a) **27 years** b) 28 years

c) 29 years d) 30 years

179) Which statement is correct for DST Women Scientist Scheme ?

a) The amount of fellowship for M.sc students will be Rs. 30,000/- PM

b) Women scientists, with M.Tech, or MD/MS, DM/MCH in Medical Sciences will be given Rs.40,000/- PM

c) Women scientists having Ph.D. A degree in Basic or Applied Sciences will be entitled to a fellowship of Rs.55,000/- PM.

d) **All of these**

"Innovation in Science Pursuit for Inspired Research" (INSPIRE)

(https://www.online-inspire.gov.in/)

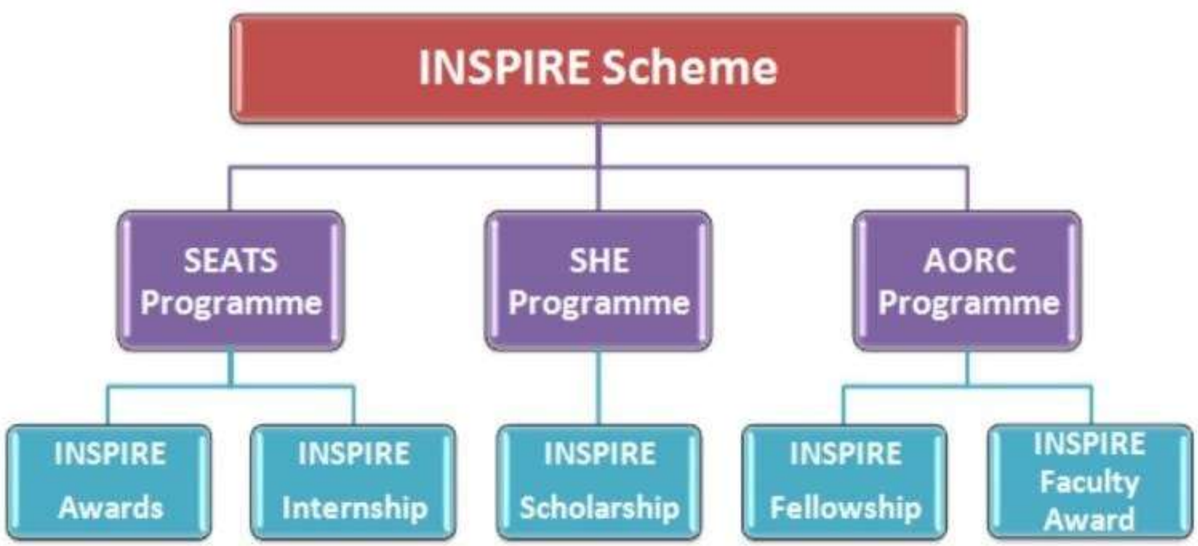
180) INSPIRE Faculty Fellowship Scheme is a component under INSPIRE for young researchers in the age group of

a) **27-32 years** b) 25-32 years

c) 27-30 years d) 25-30 years

181) How many scheme under INSPIRE ?

a) **3** b) 5 c) 4 d) 6



182) Which are the name of the INSPIRE schemes

a) Scheme for Early Attraction of Talent (SEATS)

b) Scholarship for Higher Education (SHE)

c) Assured Opportunity for Research Careers (AORC)

d) **All of these**

183) SEATS aims for the students by providing **INSPIRE Award** of Rs 5000 to one million young learners from class

a) **VI to Class X** b) VII to Class X

c) VIII to Class X d) All of these

184) The scheme **SHE** offers 10,000 Scholarship every year in the age group 17-22 years with Rs.

a) **80,000** b) 50,000 c) 40,000 d) 1lakh

185) Which are true ?

INSPIRE AORC is given

a) For 2 years, the selected fellows receive a monthly amount of INR 25,000.

b) For the last 3 years, the fellows receive INR 28,000 per month.

c) Fellows also receive House Rent Allowance (HRA) and a contingency grant of INR 20,000 per annum.

d) **All of these**

186) I have completed my B.Sc. course. I wish to avail one-year break from studies before joining M.Sc. course. Will my scholarship be continued?

a) Yes b) **No**

187) Age criterion for applying for SHE

a) **17-22** b) 18-23 c) 16- 23 d) 20-25

188) Swami Vivekananda Scholarship is also known as

a) **Bikash Bhavan Scholarship** b) Nabanna scholarship

189) The scholarship amount ranges from (HS, UG Honors, PG, Medical, Engineering, Nursing, Paramedical, Diploma)

a) **INR 12,000 to INR 60,000 per annum.**

b) INR 20,000 to INR 60,000 per annum.

c) INR 12,000 to INR 70,000 per annum.

d) INR 12,000 to INR 80,000 per annum.

190) Kanyashree K3 scholarship for

a) **P.G Students** b) U.G Students

191) To apply K3 student have to pass an UG degree with percentile

a) **45%** b) 40% c) 60% d) 55%

192) Under K3 Scheme Science students will receive per month Rs.

a) **2500** b) 2000 c) 4000 d) 1000

Career counselling for recent graduate/alumni

Department of Mathematics, Mugberia Gangadhar Mahavidyalaya organised a career counselling program entitled “Career counselling for recent graduate/alumni” on 14th May, 2022 through virtual platform using Google Meet. Dr. Swapan Kumar Misra, principal of this college inaugurated the program on virtual platform. **Mr. Tapan Mahapatra, a senior software engineer of TCS, Kolkata**, was the main speaker of this program. Total 93 students (Male: 53 and Female: 40) with 12 faculty members (Male: 10 and Female: 02) participated in this program. Most of the students of UG, PG and nearly 25 alumni were participating in this program to acquire knowledge for their future scope of career opportunity (like M.Tech, Ph.D., in Data Science or Machine Learning or Artificial Intelligence) and job opportunity in software industry. Finally, five students asked various type of questions related to industry job to the speaker and the speaker discussed their questions in details to satisfy them. The program was successful.

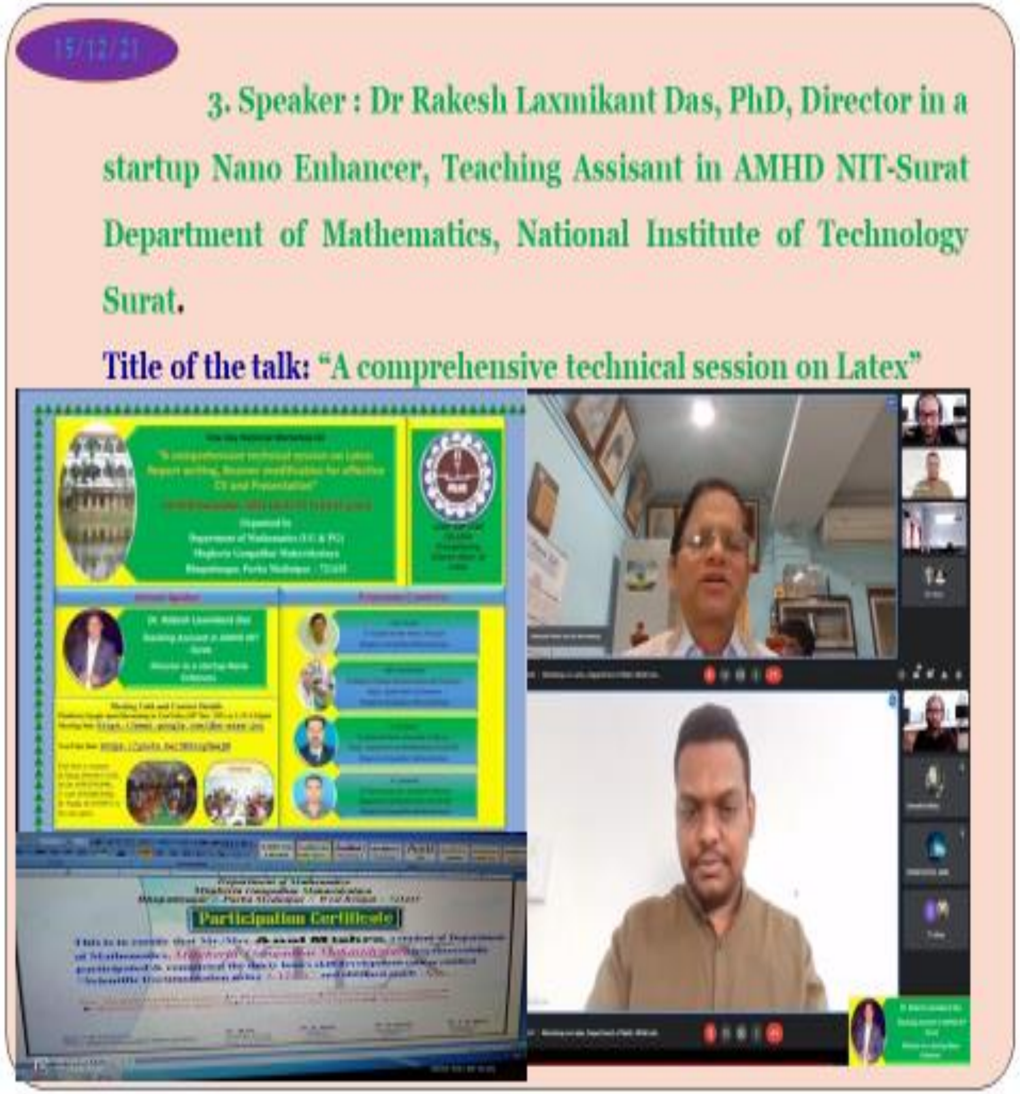
Career counselling for recent graduate/alumni

Department of Mathematics organised One Day International Webinar On

"PATHWAYS TO AMERICAN DREAM"

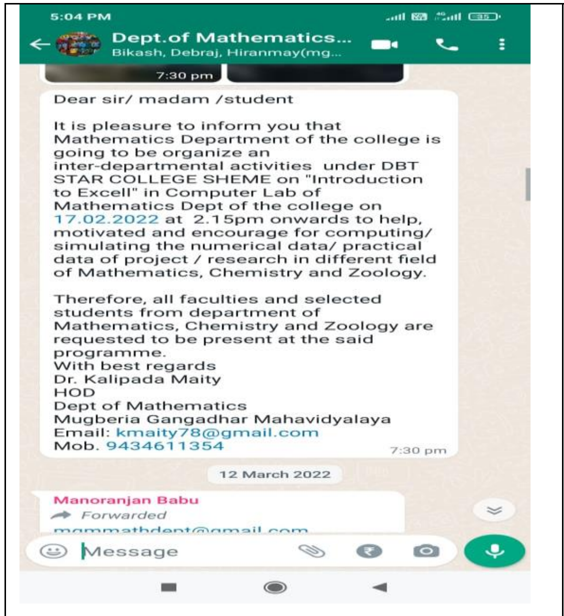
on 07th May, 2022 (at 07:30p.m. to 08:30 p.m.) through virtual platform using Google Meet. Dr. Swapan Kumar Misra, principal of this college inaugurated the program on virtual platform. **Dr. Dilip Jana, Principal Data Scientist in Walmart Company, Texas, United States** was the main speaker of this program. Total 112 students (Male: 61 and Female: 51) with 14 faculty members (Male: 12 and Female: 02) participated in this program. Most of the students of UG, PG and nearly 35 alumni were participating in this program to acquire knowledge for their future scope of career opportunity (like M.Tech, Ph.D., in Data Science) and job opportunity in online industries (Amazon, Walmart, Flipcart, etc.). Finally, five students asked various type of questions related to JRE, TOEFL tests to the speaker and the speaker discussed their questions in details to satisfy them. The program was successful.

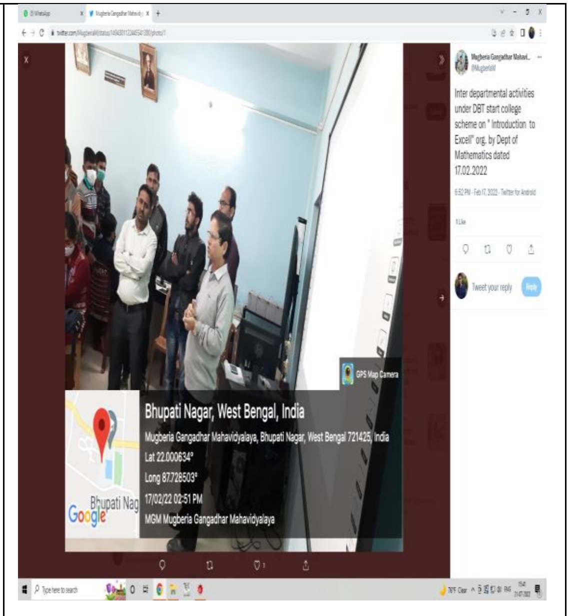
A comprehensive technical session on Latex: Report writing, Beamer modification for effective CV and Presentation

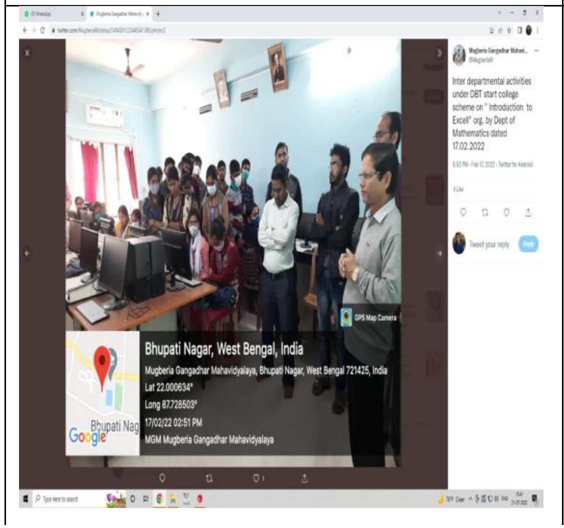


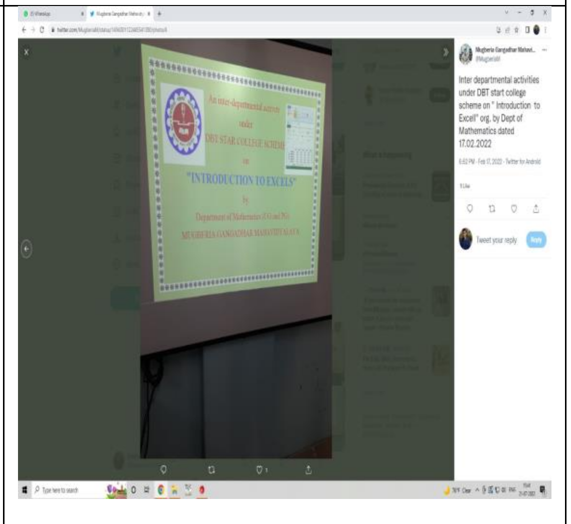
Department of Mathematics of Mugberia Gangadhar Mahavidyalaya organized One day national workshop on "**A comprehensive technical session on Latex: Report writing, Beamer modification for effective CV and Presentation**" on 18th December 2021 (1:15-3:15pm) using the platform Google meet Streaming in YouTube to motivate and cautious the large number of people and specifically young mathematicians including those at the beginning of their careers- such as B.Sc. and M.Sc. students, research scholars and others to enlighten the scope during this crisis period. Dr. Swapan Kumar Misra, principal of this college inaugurated the program on virtual platform. ***Dr. Rakesh Laxmikant Das, Teaching Assistant in AMHD NIT - Surat, Director in a startup Nano Enhancer*** was the main speaker. Currently, Dr. Rakesh is working as a Teaching Assistant at the Dept. of Mathematics and Humanities, SVNIT. Consequently, he is also a co-founder and a director of a startup called "Nano Enhancer" incubated at ASHINE, SVNIT. His product is specialized in the areas of crude refinery, diamond industry, and abrasive industries. Total 104 students (Male: 65 and Female: 39) with 11 faculty members (Male: 09 and Female: 02) participated in this program. Most of the students of UG, PG and nearly 28 alumni were participating in this program to acquire knowledge to write repot, research paper, question and beamer presentation using Latex in offline as well as online platform. Some students asked various type of questions related to referencing, citing articles, automatically updated equation, caption and label number for tables and figures to the speaker and the speaker answered them satisfactorily. This workshop had been achieved its goal and grand success.

Introduction to Excel









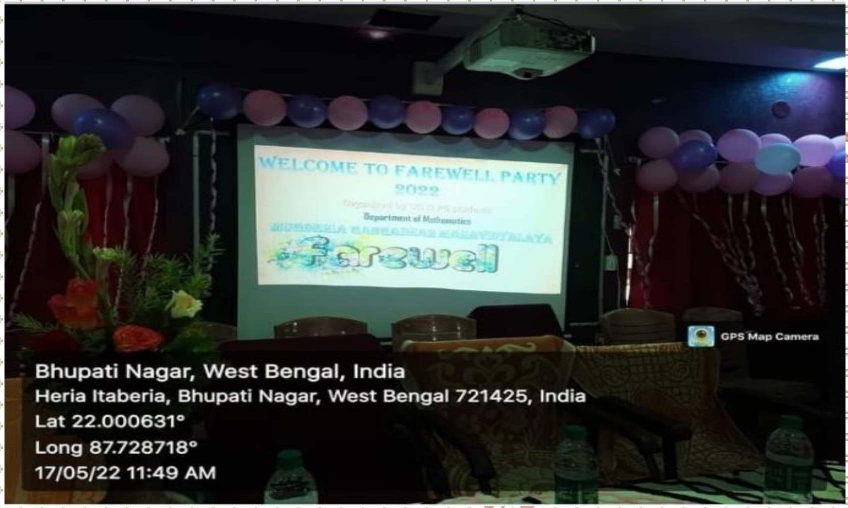
Department of Mathematics organised an inter departmental workshop program entitled "Introduction to Excel" on 17th February, 2022 at 02:15pm onwards to help, motivate and encourage for computing simulating the numerical data / practical data of project / research paper in different field of Mathematics, Chemistry and Zoology in Computer Lab of Mathematics Department under DBT start college Strengthening scheme. Dr. Swapan Kumar Misra, principal of this college inaugurated the program. The Joint co-ordinators Dr. Bidhan Ch. Samanta & Dr. Kalipada Maity were thanks to DBT and the organizing Department. **Dr. Manoranjan De, Assistant Professor, Department of Mathematics** was the main speaker of this program. He nicely presented his PPT and involved all the students for hands-on session. Total 62 students (Male: 37 and Female: 25) with 14 faculty members (Male: 09 and Female: 05) among above three departments participated in this program. They acquired the most of the knowledge of excel. Finally, three students asked various type of questions related to advanced excel and the speaker discussed their questions in details to satisfy them. Dr. De also promised that he will teach another session to learn advanced excel, for better understanding in computation and simulation problem. Thus the workshop was successful.

MATHEMATICS FORUM: FAREWELL REPORT- 2022

Mugberia Gangadhar Mahavidyalaya,

Purba Midnapore, West Bengal, India

FAREWELL PARTY



Mathematics Forum was organized Farewell Party "NEVER SAY GOODBYE" on 17th May 2022 in the S.N. Bose Seminar Hall of Mugberia Gangadhar Mahavidyalaya where students of M.Sc 2th sem & B.Sc 4th Sem & 2nd sem bid farewell to the outgoing students of M.Sc 4th sem & B.Sc 6th sem with great enthusiasm and off course nostalgia.

At 11.00 a.m Function began with a floral welcome of Chief Guest Dr. Swapan Kumar Mishra, Principal Of Mugberia Gangadhar Mahavidyalaya, Dr.Bidhan Chandra Samanta Associate Professor &H.O.D Dept. of Chemistry & TCS, Dr.Prasenjit Ghosh Associate Professor &H.O.D Dept. of History, IQAC co-ordinator Dr.Swapan Sarkar Associate Professor &H.O.D Dept. of Bengali ,Dr.Sk. Wadut Assistant Professor & H.O.D Dept. of Physics by students .

Lamp Lighting Ceremony was done by Dr. Swapan Kumar Mishra, Dr. Bidhan Chandra Samanta, Dr. Prasenjit Ghosh, Dr. Swapan Sarkar, Dr. Sk. Wadut, Dr. Kalipada Maity, Dr. Manoranjan De, Prof. Suman Kumar Giri , Prof. Devraj Manna, Prof. Hironmoy Manna, Prof. Bikash Panda, Prof. Goutam Kumar Mandol, Prof. Santu Hati & All Students.

Then principal Dr. Swapan Kumar Mishra in his speech wished good luck to all outgoing students of M.Sc 4th sem & B.Sc 6th sem for their future and appreciated the efforts during their college period. He also expressed his hope that students will continue holding top positions in the university.

Dr. Kalipada Maity, Associate Professor & H.O.D. Dept. of Mathematics had mentioned for the best efforts & significant contribution of the outgoing student regarding Wall Magazine publications, Departmental Seminars, Teacher's day celebration, Participation in Model Competition & Field Visit, Good presentation of project works and obeyed the regards to all teachers & obeyed the discipline of the dept. etc during their college life. Dr. Maity also encouraged the student for participating in GATE, NET & SET examinations.

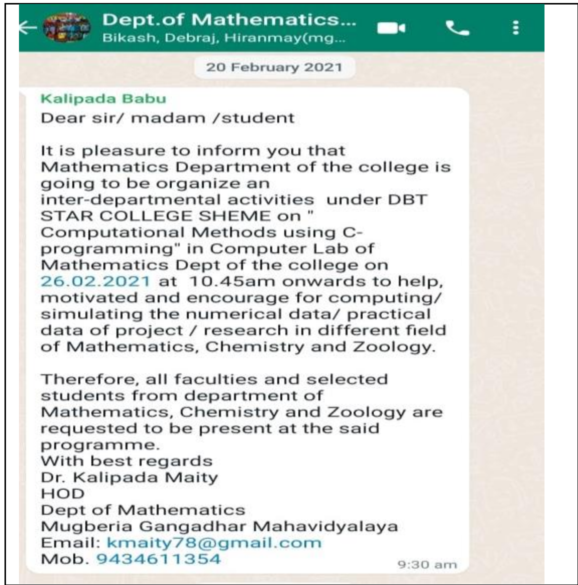
Dr. Manoranjan De, Assistant Professor, Dept. of Mathematics encouraged the student how they could avail various type of scholarship to do their higher study. Dr. De wished to help them to select their research guides at University / NIT / IIT in future.

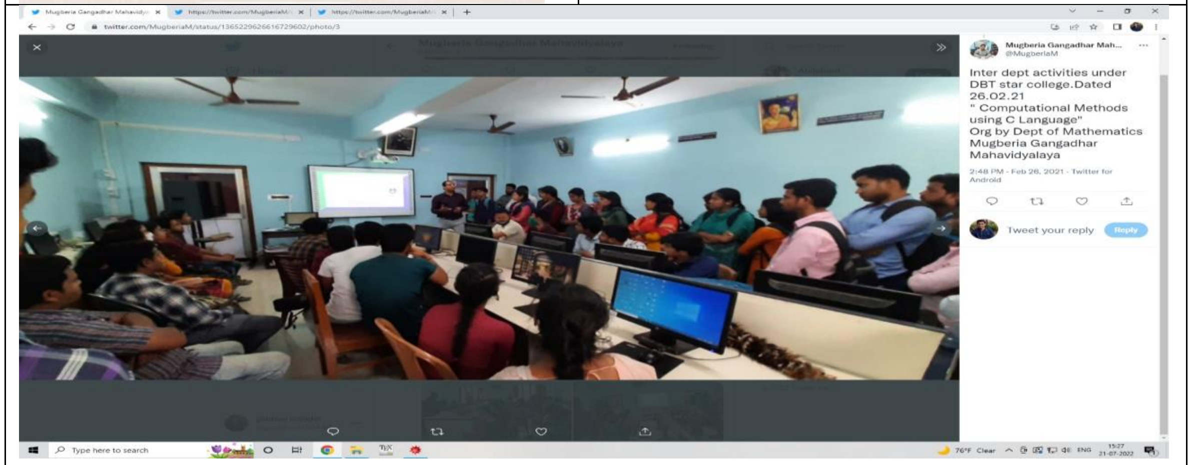
Prof. Bikash Panda had shared his experience in front of all students how they could face the interview in any academic / service purpose.

Total 135 students (Male 74 & Female 61) and 13 teachers (Male 13) were participating in this program.

The program was very much successful.

A computational Method using C-Programming





Department of Mathematics organised an inter departmental workshop program entitled "A computational Method using C-Programming" on 26th February, 2021 at 10:45am onwards to help, motivate and encourage for computing simulating the numerical data / practical data of project / research paper in different field of Mathematics, Chemistry and Zoology in Computer Lab of Mathematic's Department. Dr. Swapan Kumar Misra, principal of this college inaugurated the program. Dr. Manoranjan De, Assistant Professor, Department of Mathematics was the main speaker of this program. He involved all the students for hands-on session using offline and online mode. Total 74 students (Male: 42 and Female: 32) with 12 faculty members (Male: 09 and Female: 03) among above three departments participated in this program. They enjoyed the hands-on session and learned the programming code without doubt. Finally, the speaker discussed advanced computation methods to motivate the students. Thus, this activity was successful.

Wall Magazine Report

Total number of Participants:
128 (Male:68, Female:60)

Title: **Mathematical Diary**
Year of Publication: **2022 (march)**

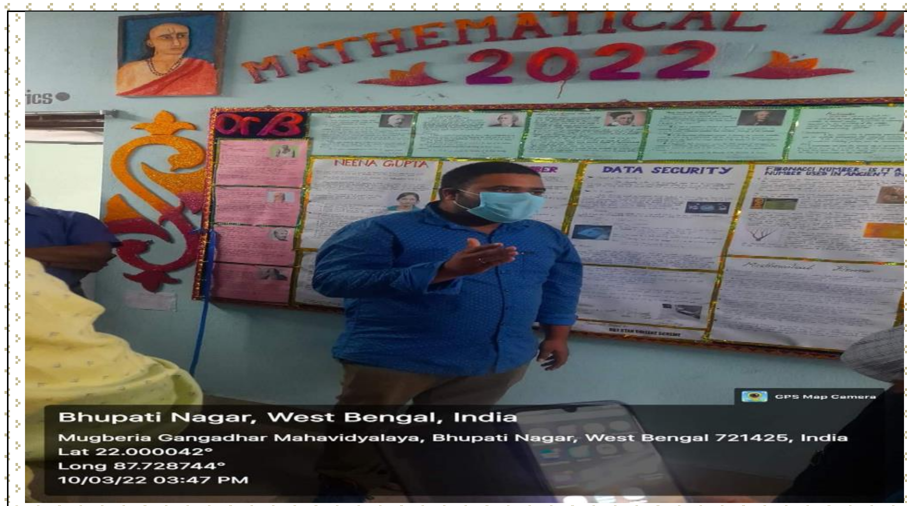
Inaugurated by:	Dr. Swapan Kumar Misra, Principal, MGM
Convener:	Mr. Hiranmoy Manna
Published by:	Department of Mathematics (UG & PG)
Financially Helped by:	**DBT STAR COLLEGE**
SCHEME	

Other person presents:
Dr. Kalipada Maity (HOD (Dept. of Mathematics)
Dr. Bidhan Chandra Samanta (HOD dept. of chemistry)
Dr. Prasenjit Ghosh (HOD Dept. of History)
Dr. Manoranjan De (Dept. of Mathematics)
Suman Kumar Giri (Dept. of Mathematics)
Debraj Manna (Dept. of Mathematics)
Hiranmoy Manna (Dept. of Mathematics)
Bikash Panda (Dept. of Mathematics)
Madhumita Sahoo Giri (Dept. of Mathematics)
Santu Hati (Dept. of Mathematics)
Goutam Kumar Mondal (Dept. of Mathematics)

Different Mathematician and contribution published in Wall Magazine

	Topic with presentation	Student name	Semester(UG/PG)
1	Data Security	Manoj Maity	6th (UG)
2	Neena Gupta	Sougata Bera	4th (UG)
3	ISBN Number	Sudeshna Mity	2nd (UG)
4	Super Golden Ratio	Subhendu Bhunia	4th (PG)
5	One's life in Mathematics	Gouttam Jana	2nd (PG)
6	Golden Ratio	Sougata Bera	4th (PG)
7	Mathematical Finance	Poushali Tripathy	2nd (PG)

Mathematician's Name	Students Name	Semester
Brahmagupta	Harekrishna Maity	4th sem(UG)
Aryabhata	Moumita Tunga	4th sem(PG)
Pythagoras	Parthapratim sahoo	4th sem(UG)
Euclid	Megha Santra	6th sem(UG)
George Cantor	Susmita Pahari	4th sem(PG)
Leonhard Euler	Indrani Das	6th sem(UG)
Carl Friedrich Gauss	Gurupada Jana	4th sem(PG)
Jean le road D'Alembert	Saswati Giri	6th sem(UG)
Archimedes	Bithi Maikap	6th sem(UG)
Augustus Louis Cauchy	Subha Pradhan	4th sem(PG)
Srinivasa Ramanujan	Swarnendu Pradhan	4th sem(PG)
Niels Henrik Abel	Surajit Bhanja	4th sem(PG)
Akshay Venkatesh	Suryasekhar Giri	4th sem(PG)



Written by:

Kuheli Mondal 4^{th} *sem(PG)*
Sougata Bera 4^{th} *sem(PG)*
Sayani Sinha 4^{th} *sem(PG)*
Saswati Giri 4^{th} *sem(PG)*

Decorated by:

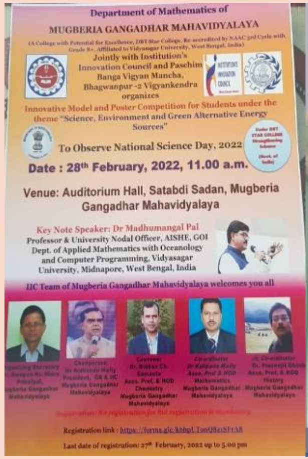
Arijit Maity 4^{th} *sem(PG)*
Anwesha Samnta 6^{th} *sem(PG)*
Ranjit Pradhan 6^{th} *sem(PG)*
Santu Bera 6^{th} *sem(PG)*
Parthapratim Matiy 6^{th} *sem(PG)*
Pabitra Mondal 6^{th} *sem(PG)*
Pradip Maity 6^{th} *sem(PG)*

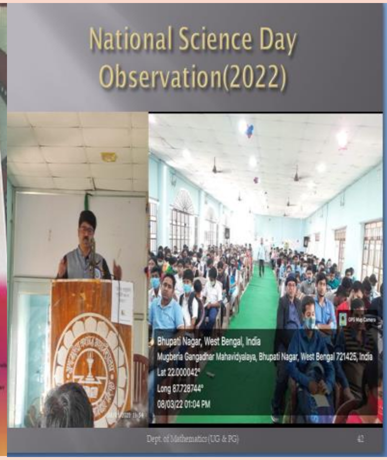
National Science Day Observation

28/02/22

2. Speaker: Dr. Madhumangal Pal, Professor, Department of Applied Mathematics with Oceanology and Computer Programming , Vidyasagar University, West Bengal.

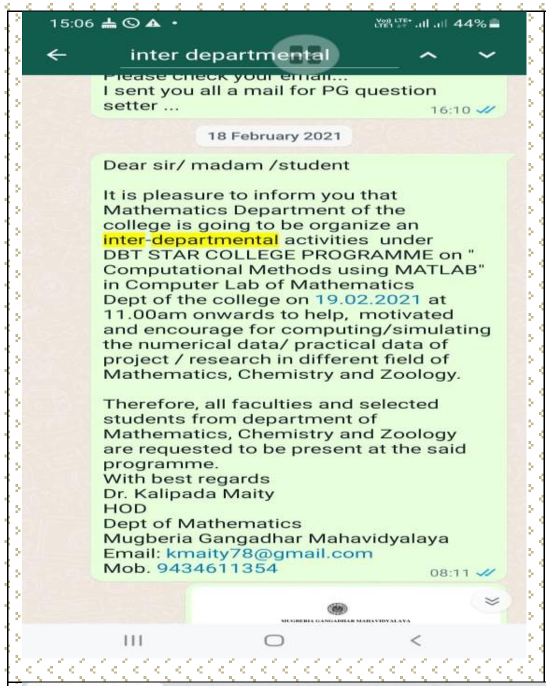
Title of the talk: "Science Environment and Green Alternative Energy Sources "

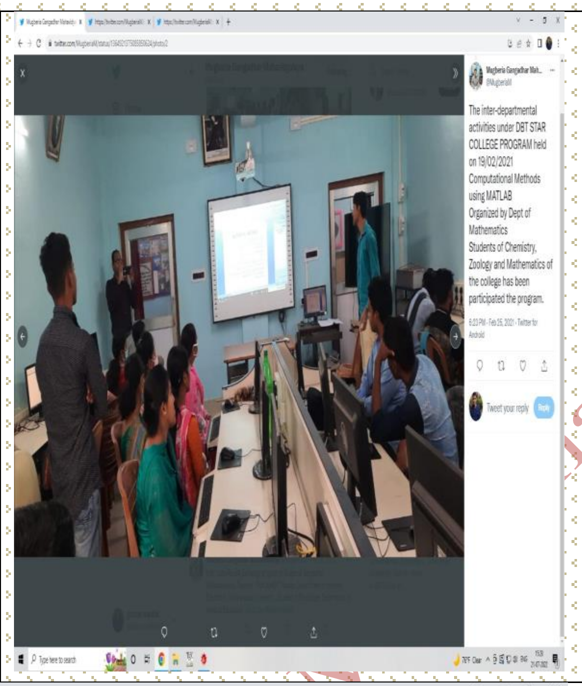


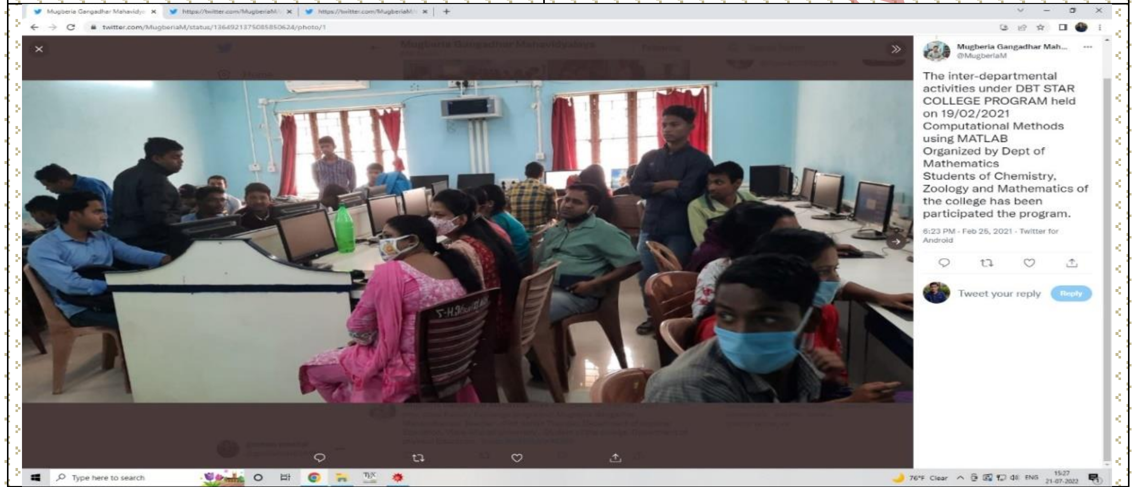


Department of Mathematics of Mugberia Gangadhar Mahavidyalaya jointly with Institution's Innovation Council and Vigyankendra organized **Innovation Model and Poster Competition for students under the theme "Science, Environment and Green Alternative Energy Sources"** for observing "**National Science Day Observation**" on 8th March, (**Instead of 28th February)** 2022 at 11:00 am onwards to help, motivate and encourage for depending on science and discuss the various purpose of science in Mathematics, Chemistry and Zoology. Prof. (Dr.) Swapan Kumar Misra, Principal of this college inaugurated the program. Prof. (Dr.) Madhumangal Pal, Professor, Department of Applied Mathematics with Oceanology and Computer Programming, Vidyasagar University, West Bengal, was the Key note speaker of the said program. He nicely presented his PPT and involved all the students for hands-on session. Total 182 students (Male: 94 and Female: 88) with 14 faculty members (Male: 09 and Female: 05) from different schools and colleges were participating with several type of models and posters related to the topic. Prof(Dr.) M. Pal nicely presented and conveyed his experience about ''Science, Environment and Green Alternative Energy Source'' Finally, three students asked various type of questions related to green alternative energy source and the speaker discussed their questions in details to satisfy them. Prof.(Dr.) Pal also promised that he will teach another session to speak any other topics of science. Thus the science day observation was successful.

Computational Method using Matlab



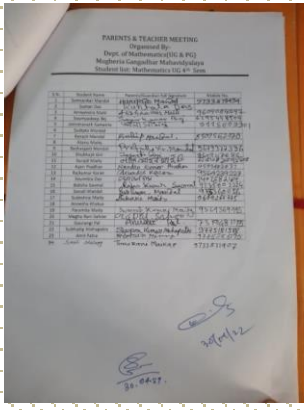
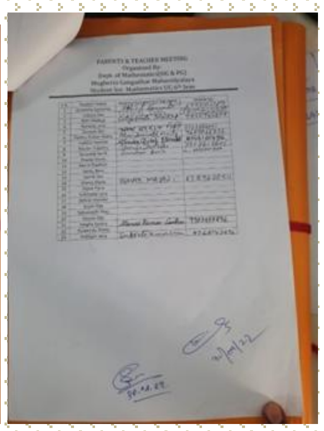
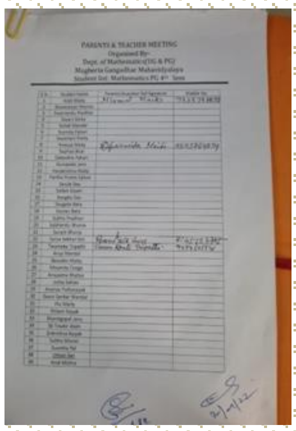
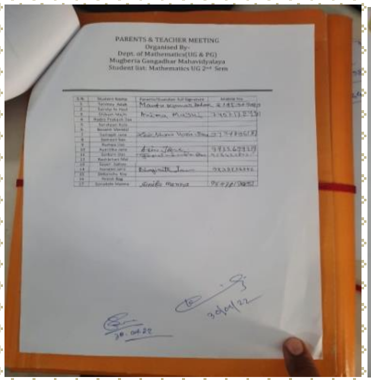
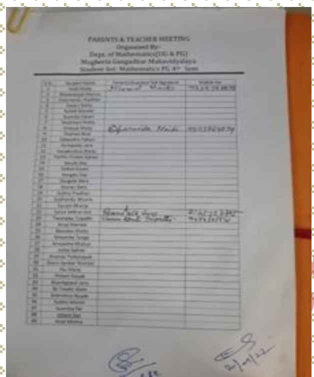
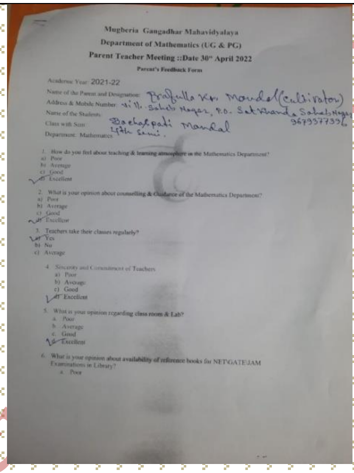
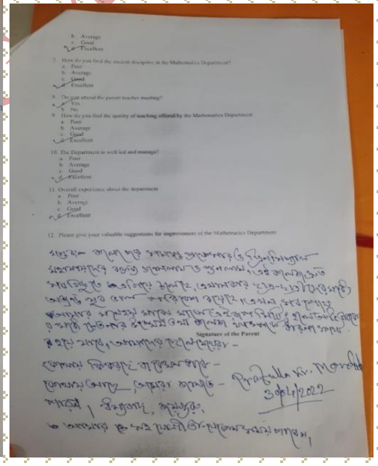
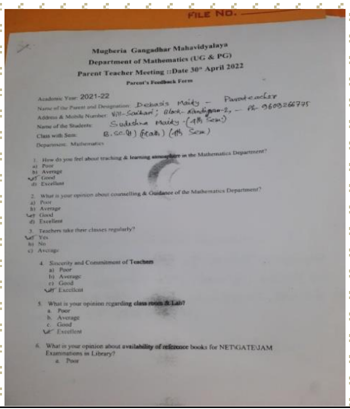
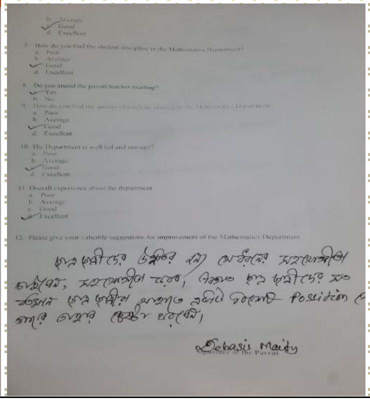




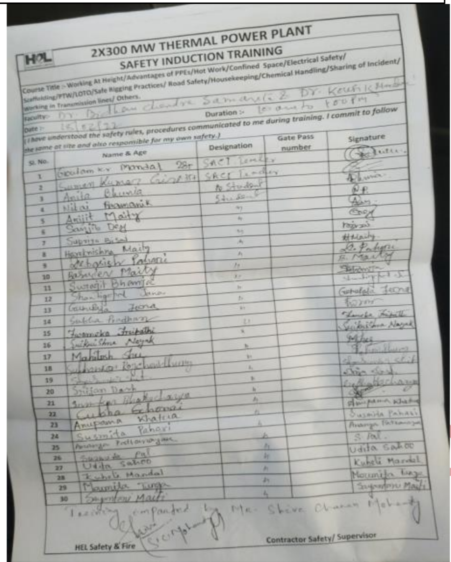
Department of Mathematics organised an inter departmental workshop program entitled "Computational Method using Matlab" on 19th February, 2021 at 11:00 am onwards to help, motivate and encourage for computing simulating the numerical data / practical data of project / research paper in different field of Mathematics, Chemistry and Zoology in Computer Lab of Mathematic's Department. Dr. Swapan Kumar Misra, principal of this college inaugurated the program. Mr. Santu Hati, Research Scholar, Department of Mathematics was the main speaker of this program. He involved all the students for hands-on session using offline and online mode. Total 72 students (Male: 43 and Female: 29) with 10 faculty members (Male: 08 and Female: 02) among above three departments participated in this program. They enjoyed the hands-on session and learned the programming code without doubt. Finally, the speaker discussed advanced computation methods to motivate the students. This program was successful.

Parents and Teacher Meeting

Department of Mathematics organised parents and teacher meeting on 30th April 2022 at 12:15pm onwards to collected the feed backs from parents and make a relation between parents and teachers. Total 49 (male-34 and female-15) parents, 9 faculty members (male-08 and female-01), IQAC coordinator and principal were present at the said meeting in the department. Our principal sir first delivered the well come address in front of all the parents and teacher and he remembered that the parents meeting must play an important role to make a better academic environment in the department. Any positive/negative information of the department are shared to all the parents through this meeting. Dr. Kalipada Maity, HOD convey his respect to all faculty members, parents and principal. He specially thanks to Prof Suman Kumar Giri for his planning and best effort for organizing such type of successful meeting. Every parents convey his/her respect /thanks to the department for organizing such type of meeting. The department collected the feedback report from all parents. They are satisfied by different academic activities like as regular class teaching, seminar, wall magazine, large number of reference books in central library, modern class rooms and computer lab, mentoring and tutorial class for JAM/GATE/NET/SET examinations. Finally, some parents requested to department to organize some career counselling programme. Our program is successful.

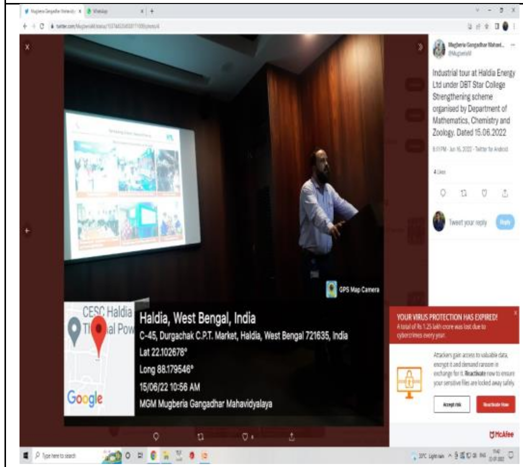
.Parents signature data	Parents feedback report
    	   

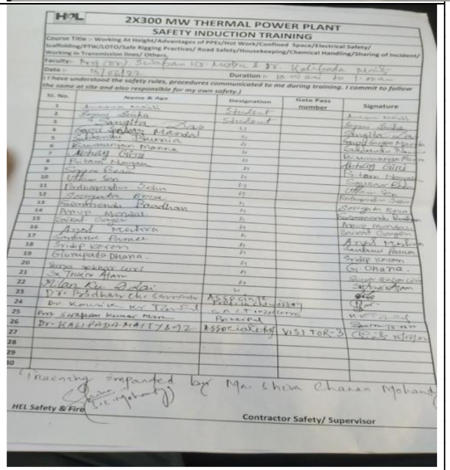
Industrial Visit to Haldia Energy Limited, Haldia, Purba Medinipur (15-06-2022)


2X300 MW THERMAL POWER PLANT
SAFETY INDUCTION TRAINING
Course Title :- Working At Height/Advantages of PPEs/Hot Work/Confined Space/Electrical Safety/ Scaffolding/PTW/LOTO/Safe Rigging Practices/ Road Safety/Housekeeping/Chemical Handling/Sharing of Incident/ Working in Transmission lines/ Others.
Faculty:
Date :
Duration :-
(I have understood the safety rules, procedures communicated to me during training. I commit to follow the same at site and also responsible for my own safety.)

Sl. No.	Name & Age	Designation	Gate Pass number	Signature

HEL Safety & Fire
Contractor Safety/ Supervisor




2X300 MW THERMAL POWER PLANT
SAFETY INDUCTION TRAINING
Course Title :- Working At Height/Advantages of PPEs/Hot Work/Confined Space/Electrical Safety/ Scaffolding/PTW/LOTO/Safe Rigging Practices/ Road Safety/Housekeeping/Chemical Handling/Sharing of Incident/ Working in Transmission lines/ Others.
Faculty:
Date :
Duration :-
(I have understood the safety rules, procedures communicated to me during training. I commit to follow the same at site and also responsible for my own safety.)

Sl. No.	Name & Age	Designation	Gate Pass number	Signature

HEL Safety & Fire
Contractor Safety/ Supervisor

Department of Mathematics

Visits to industry and important labs of national eminence (02-03-2021)

दीघा विज्ञान केन्द्र एवं राष्ट्रीय विज्ञान शिविर
(राष्ट्रीय विज्ञान संग्रहालय परिषद)
संस्कृति मंत्रालय, भारत सरकार

DIGHA SCIENCE CENTRE & NATIONAL SCIENCE CAMP
(A unit of National Council of Science Museums)
Ministry of Culture, Govt. of India

Ref. No. DIGH-11016

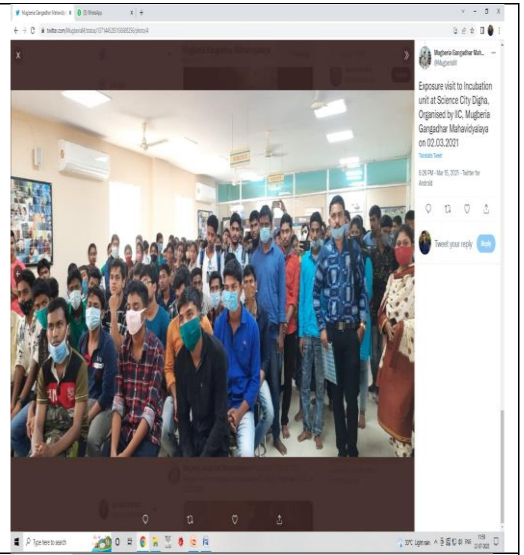
Date 03-03-2021

To whom it may concern

This is to certify that 102 numbers of students along with 18 numbers of school teachers from Mugberia Gangadhar Mahavidyalaya, Bhupatinagar, Purba Medinipur, West Bengal Pin-721425 have visited Digha Science Centre for Student's Exposure Visit on March 2, 2021 as per office record. Entry tickets and Show tickets have been issued in favor of them for the aforesaid reason at approved concessional rate respectively. Interactive Science Demonstration on various topics (Physics, Chemistry & Mathematics) has been performed for the students and brief exposure about the Innovation Hub has been given to interested students which may be helpful for their carrier. In this regard necessary action may kindly be initiated in favor of them.

Niranjan Gupta
Project Coordinator
Digha Science Centre

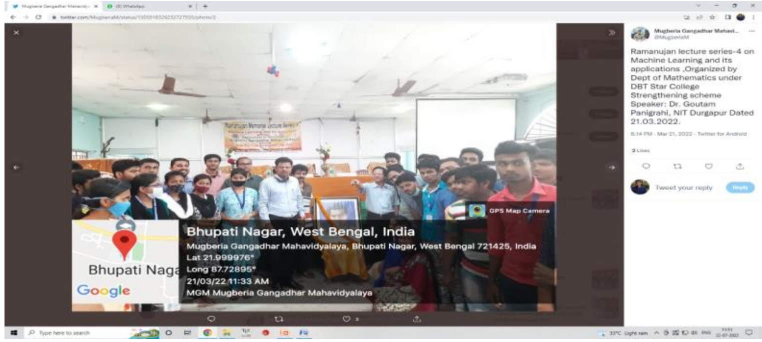
Foreshore Road, New Digha, Midnapore (East)-721463
Phone : 03220 266360, Email : dscdigha@gmail.com



A Workshop and Lab Exposure at Digha Science Centre were held on 02-03-2021 under DBT Star College Strengthening Scheme to do hand on experiment for UG and PG students of Mathematics, Chemistry and Zoology Departments. Total 102 (male-64 and female-38) parents, 18 faculty members (male-14 and female-04). Mr. Biswajit Das, Education officer, Digha Science Centre shared his experience about various type science magic in front of us. Students are performed different kind of hand on experiment under his guidance.

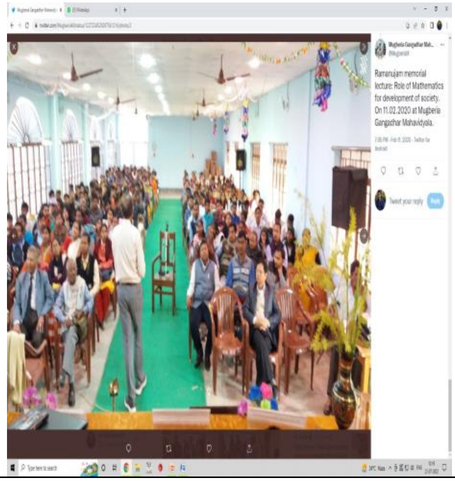
As a result, the students are motivated by observing the science magic. They requested our department to organize that type of program in every year.

Ramanujan Memorial lecture series-4 on "Machine learning and its Application **(21-03-2022)**



Department of Mathematics organised a Ramanujan Memorial lecture series-4 on "Machine learning and its Application" on 21th March, 2022 at 11:00 am onwards to motivate and encourage the UG & PG students of Mathematics for creating interest in the subject and also to enlighten future scope in the field of Mathematics. 121 (Male: 73 and Female: 48) students and teachers of Mathematics' Department, participated in this memorial lecture. Dr. K. Maity, HOD, delivered his speech about the life history of Ramanujan. Some mathematical magic and open problems were delivered by Mr. Goutam Kumar Mandal, Teacher of the Math. Dept. The key note speaker Dr. Goutam Panigrahi, Assistant Professor, Department of Mathematics, NIT-Durgapur, delivered his lecture on "Machine learning and its Application". He also told that the students can avail a scope of research in this field. He also appreciated the Department for teaching the Matlab course. He also suggested to introduce Latex and Python certificate courses in future. We hope that the program was successful.

Outreach activities (11-02-2020)



Inaugurated by: Dr. Swapan Kumar Misra, Principal
Key note Speaker1: Prof. J.C. Mishra, IIT KGP
Speaker2: Prof. Manoranjan Maiti, VU

Title: Role of Mathematics in the Development of Society

Department of Mathematics organised a Ramanujan Memorial lecture series-3 on "Role of Mathematics in the Development of Society" on 11^{th} February, 2020 at 11:00 am onwards to motivate and encourage the MP, HS, UG & PG students of Mathematics for creating interest in the subject and also to enlighten future scope in the field of Mathematics. More than 200 (Male: 124 and Female: 76) students and teachers from different schools and colleges participated in this memorial lecture. Dr. K. Maity, HOD, delivered his speech regarding the role of mathematics in economics, infrastructure, finance, management, etc. for the development of society. The students are highly motivated for their higher study and research by the presentation and discussion of Prof. M. Maiti. The students also learned the application of mathematics in medical science by the presentation of Prof. J.C. Mishra. Many students asked different kind of questions and the resource person satisfied them. We hope that the program was successful.

Workshop and Lab Exposure at Digha Science Centre and Marine Aquarium (11-03-2022)

MUGBERIA GANGADHAR MAHAVIDYALAYA
ESTD.—1964
P. O.—BHUPATINAGAR Dist.—PURBA MEDINIPUR
S. T. D. Code—03220 Ph. No.—270236, Pin.—721425 (W. B.)

Ref. No.—M. G. M. / / / Dated.............

From : The Principal / Secretary.

Date: 10-03-2022

To
The Director,
Digha Science Center,
Digha, Purba Medinipur

SUB: SCIENCE CENTER VISIT

Respected Sir,

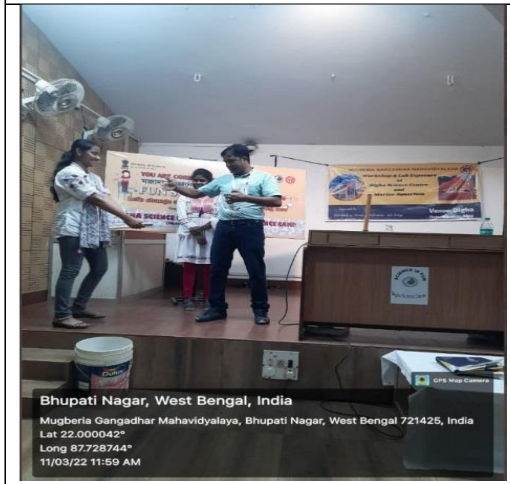
The following students and teachers (Total number- 175) of Mugberia Gangadhar Mahavidyalaya are going to visit at science center, Digha on 11-03-2022.

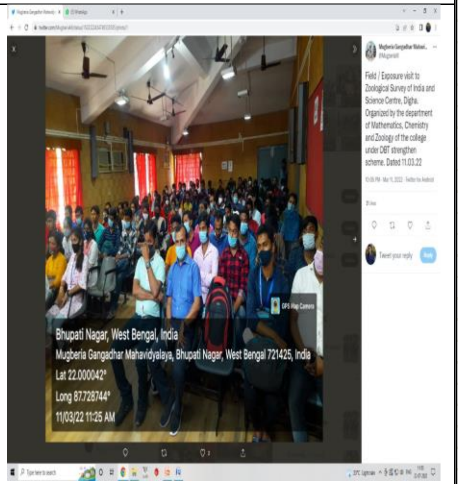
This is for your kind perusal and treat the matter officially.

With best wishes

10-03-22
Dr. Swapan Kumar Misra
Principal
Mugberia Gangadhar Mahavidyalaya

Principal
Mugberia Gangadhar Mahavidyalaya





A Workshop and Lab Exposure at Digha Science Centre and Marine Aquarium were held on 11-03-2022 under DBT Star College Strengthening Scheme to do hand on experiment for UG and PG students of Mathematics, Chemistry and Zoology Departments. Total 158 (male-95 and female-63) parents, 14 faculty members (male-11 and female-03). Mr. Biswajit Das, Education officer, Digha Science Centre shared his experience about various type science magic in front of us. Students are performed different kind of hand on experiment under his guidance. Our students also visit Marine Aquarium and finally they take the lunch.

As a result, the students are motivated by observing the science magic. They requested our department to organize that type of program in every year.

Project / Dissertation Work Presentation 2021

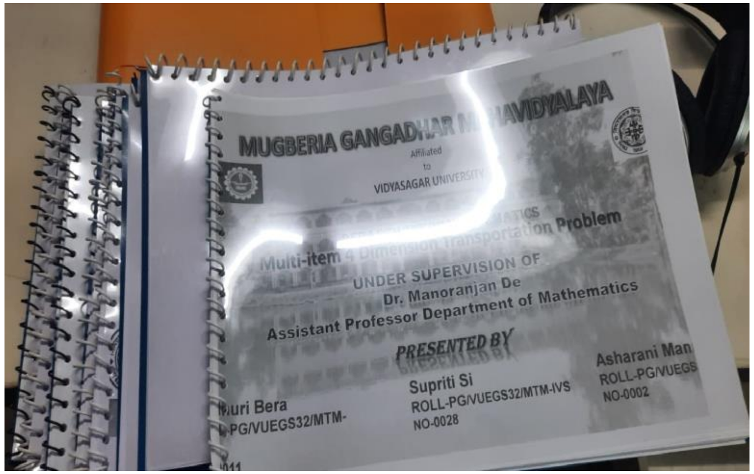
Mugberia Gangadhar Mahavidyalaya
Final Project Presentation
Department of Mathematics
Schedule Time: 11:00AM to 01:30Pm Date:19.08.2021

Group of Professor Shyamal Kumar Mondal

Group	Name	Project title	Mentor Name
1	Debmalya Mishra Soumik Hait Modhusudan Midya	Modelling The Effect Of Immune Protection And Vaccination Against COVID19	Dr.Kalipada Maity
2	Sangita Paul Tapas Sheet Satyaki Adak	A stochastic Multi channel Revenue Management Model with time dependent demand	Dr.Kalipada Maity
3	Manish Acharyya Moumita Sahoo Chandan Giri	A fuzzy production inventory control model using Granular differentiablity approach	Mr. Santu Hati
4	Sudipta Khatua Gopal Das Seuli Dey	Numerical Approach of Multi-Objective Optimal Control Problem in Imprecise Environment	Dr.Kalipada Maity
Teleporta	Sk Sajahan Tuhina Giri Ranita Giri	Teleportation of Five-Qubit State Using Six-Qubit State [1]	Dr. Arpan Dhara [2]

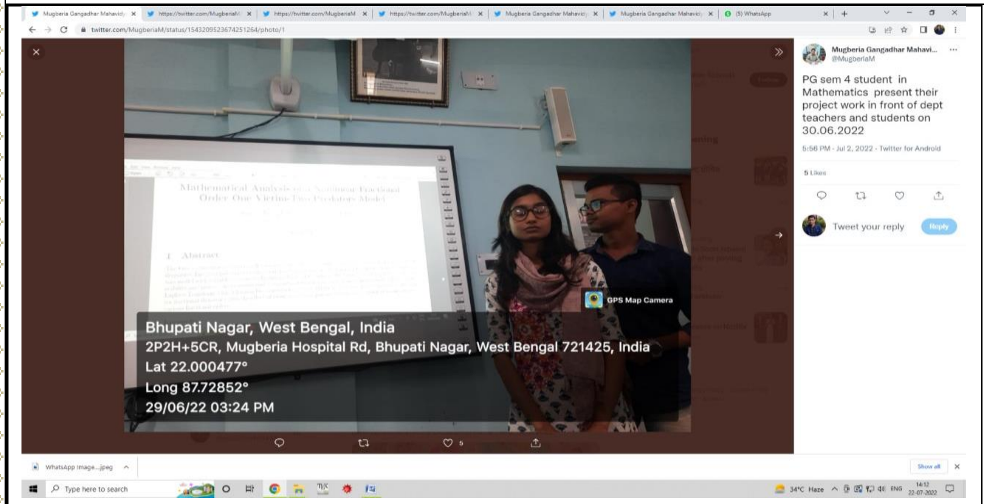
Group of Professor Sankar Kumar Roy

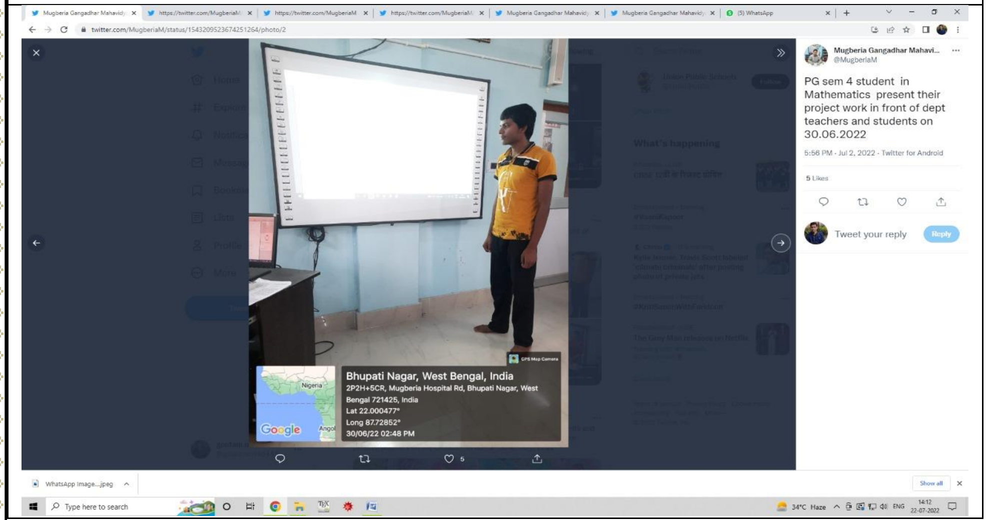
Group	Name	Project title	Mentor Name
1	Durga Mandal Gayatri Jana Gouranga Bera	Multi-Objective 4-dimensional transportation problem	Dr. Manoranjan De
2	Pallabita Maity Sima Bhunia Ansar Ali Khan	Mathematical Modelling and Control of Covid-Influenza Co-infection [3]	Dr. Anupam De
3	Bidhan Chandra Jana Sanju Sinha Suman Manna	Visceral leishmaniasis and control strategies	Dr. Debnarayan khatua
4	Madhuri Bera Supriti Si Asha Rani Bera	Multi-item 4 Dimensional Transportation Problem	Dr. Manoranjan De
5	Chayan Pradhan Nilanjan Pramanik Ramnarayan Patra	Numerical methods to solve 2D Laplace Differential Equation	Mr. Bikash panda

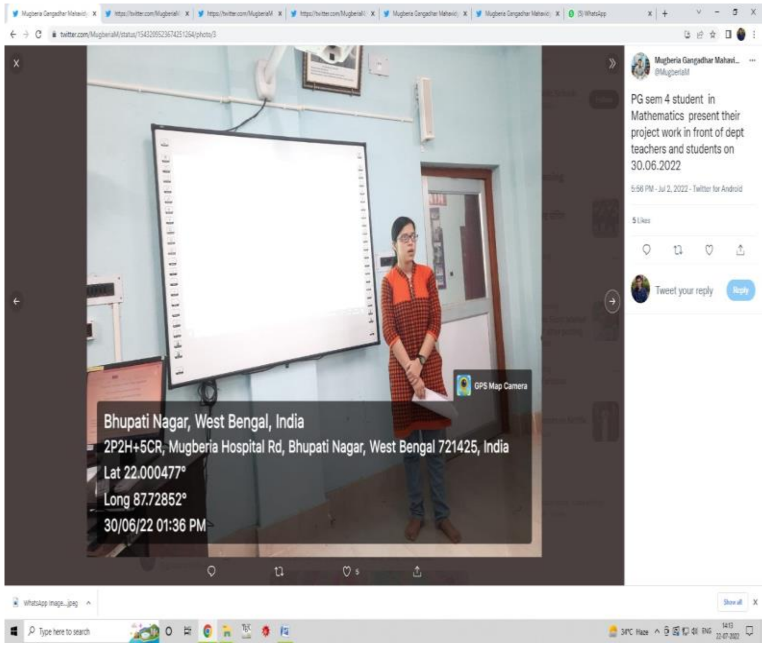


Thirty number of UG & PG students of Mathematics Department were submitting & presenting their project reports on 19-08-2021. They were presenting their presentation by making PPT and use Google Meet platform. Two Vidyasagar University professors: Prof. Shyaman Kumar Mondal & Prof. Sankar Kumar Ray were present in this virtual platform for evaluating their performance. The external experts wwre satisfied by the students. We hope that the programme was grant successful.

Power Point Presentation 2022







Thirty number of UG & PG students of Mathematics Department were presenting their project in front of departmental teachers and students 29-06-22 & 30-06-2022. They were presenting their presentation by making PPT and Beamer Latex. We hope that the programme was grant successful.

Students Success Record (2020-2022)

Ministry of Education
Government of India

Human Resource Development Group
Council of Scientific & Industrial Research

NATIONAL TESTING AGENCY

Joint CSIR - UGC NET JUNE 2020

National Testing Agency - Score Card /Result

Application Number :	201610105338	**Roll Number :**	WB10606513	
Candidate's Name :	BUBUN DAS			
Mother's Name :	ANJANA DAS			
Father's Name :	SAKTI PADA DAS			
Category :	GENERAL	**Person with Disability(PwD) :**	No	
Gender :	MALE	**Date of Birth :**	05-06-1995	
Subject :	MATHEMATICAL SCIENCES			
No of Candidates in this Subject	**Registered :** 48266	**Appeared :**	31144	
Applied For :	APPLIED FOR JRF			

Marks Obtained

Part A	8.500
Part B	54.000
Part C	42.750
Total Marks Obtained	105.250
Total Marks Obtained (in words)	ONE HUNDRED FIVE POINT TWO FIVE ZERO ONLY
Result	Lectureship/Assistant Professor
RANK	50

Dated : 28.12.2020 **Senior Director, NTA**

Note:

1. This electronically generated Score Card is the official score declared by NTA and does not require any signature.
2. Candidate's particulars including Category and Person with Disability (PwD) have been indicated as mentioned by the candidate in the online Application Form
3. The National Testing Agency has taken due care while uploading the Score Card. However, in case of any inadvertent error, the NTA reserves the right to rectify the same at a later stage.
4. No separate intimation about score card shall be issued.
5. Instructions relating to issuance/obtaining Eligibility Certificate to qualified candidates will be notified separately later by CSIR on their website www.csirhrdg.res.in.

GATE 2021 Result [MA]

Name: SUBHASISH DAS

Registration Number: MA21S56042274

Gender: Male

Subhasish Das

Parent's/Guardian's name: TAPAN DAS

Date of birth: 11-November-1996

Examination Paper: Mathematics (MA)

Marks out of 100#: 33.67

All India Rank in this paper: 976

Qualifying Marks##: 29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)

GATE Score: 435

 # Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

Note:

- The marks and score provided here are for information only.
- An electronic or paper copy of this document is not valid.
- The official GATE 2021 Score Card can be downloaded from the GOAPS site between March 30, 2021 and June 30, 2021.
- From July 1, 2021 to December 31, 2021, the GATE 2021 Scorecard can be downloaded from GOAPS portal by paying a fee of INR 500/-. From January 1, 2022, the GATE 2021 Scorecard will NOT be available.
- The GATE 2021 Scorecard will be available ONLY for the candidates who have secured marks more than or equal to the qualifying marks mentioned for SC/ST/PwD category of that paper. All other candidates will NOT get any scorecard of GATE 2021.
- For the papers CE, CS and ME, qualifying marks and score are based on the "Normalized Marks".

JAM 2021

FAQs

Contact Us

Logout

Information Brochure

Important Dates

How to Apply?

Welcome, Subhadip Sahoo

JAM 2021 Result

Name: SUBHADIP SAHOO

Category: GEN

Registration Number(s): MA613A243

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	EWS/OBC(NCL)	SC/ST/PwD	
Mathematics (MA)	13186	**32.67**	24.69	22.22	12.35	**1094**

** A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the scorecard.*

View Paper-I Response

© JAM 2021 IISc Bangalore

Digital Finger-Print: 1ea4fc883c2f27b96b43d8b4cfff59e3

GATE 2021 Result [MA]

Name: RABINDRANATH BHOJ

Registration Number: MA21S56035032

Gender: Male

Rabindranath Bhoj

Parent's/Guardian's name: PINTU BHOJ

Date of birth: 16-June-1996

Examination Paper: Mathematics (MA)

Marks out of 100#: 41.33

All India Rank in this paper: 243

Qualifying Marks##: 29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)

GATE Score: 574

 # Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

Students Success Record (2020-2022)

GATE 2021 Result [MA]

Name

SANDIP DAS

Registration Number

MA21S56035152

Gender

Male

Sandeep Das

Parent's/Guardian's name

SUBHAS CHANDRA DAS

Date of birth

10-November-1996

Examination Paper

Mathematics (MA)

Marks out of 100# 31.67

All India Rank in this paper 1326

Qualifying Marks## 29.0 26.1

GATE Score 399

JAM 2021 Joint Admission test for Masters 2021

Organizing Institute:
Indian Institute of Science Bangalore

You are logged in with Enrolment ID: S127E64

Home
JAM 2021
FAQs
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Information Brochure
Important Dates
How to Apply?

Welcome, Srikrishna Das

JAM 2021 Result

Name

SRIKRISHNA DAS

Category

GEN

Registration Number(s)

MA614A526

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	EWS/OBC(NCL)	SC/ST/PwD	
Mathematics (MA)	13186	**46.33**	24.69	22.22	12.35	**324**

*A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the scorecard.

View Paper-I Response

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GATE 2021 GATE Online Application Processing System (GOAPS)

You are logged in as: Ramkrishna Bar (B157E82) Home GATE 2021 FAQs Logout

Information Brochure
Documents For Application
Important Dates
Eligibility
FAQs
Important Notice NEW!

Welcome, Ramkrishna Bar

GATE 2021 Result [MA]

Name

RAMKRISHNA BAR

Registration Number

MA21S56035052

Gender

Male

Ramkrishna Bar

Parent's/Guardian's name

SAMARENDRANATH BAR

Date of birth

9-April-1997

Examination Paper

Mathematics (MA)

Marks out of 100# 25.0

All India Rank in this paper 3050

Qualifying Marks## 29.0 (General) 26.1 (OBC (NCL)/EWS) 19.3 (SC/ST/PwD)

GATE Score 277

Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

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- The GATE 2021 Scorecard will be available ONLY for the candidates who have secured marks more than or equal to the qualifying marks mentioned for SC/ST/PwD category of that paper. All other candidates will NOT get any scorecard of GATE 2021.
- For the papers CE, CS and ME, qualifying marks and score are based on the "Normalized Marks".

appsgate.iitb.ac.in

BUBUN DAS

Registration Number

MA21S56042022

Gender

Male

Bubun Das.

Parent's/Guardian's name

SAKTIPADA DAS

Date of birth

5-June-1995

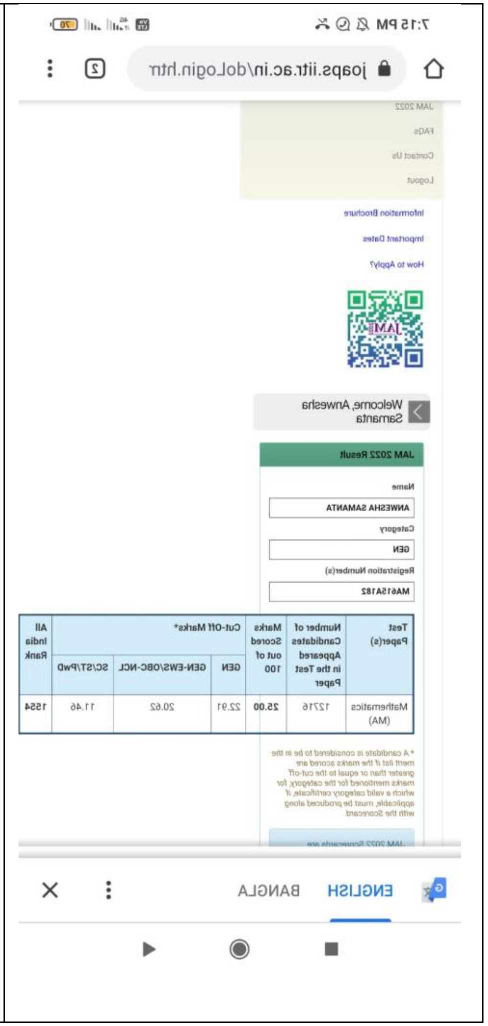
Examination Paper

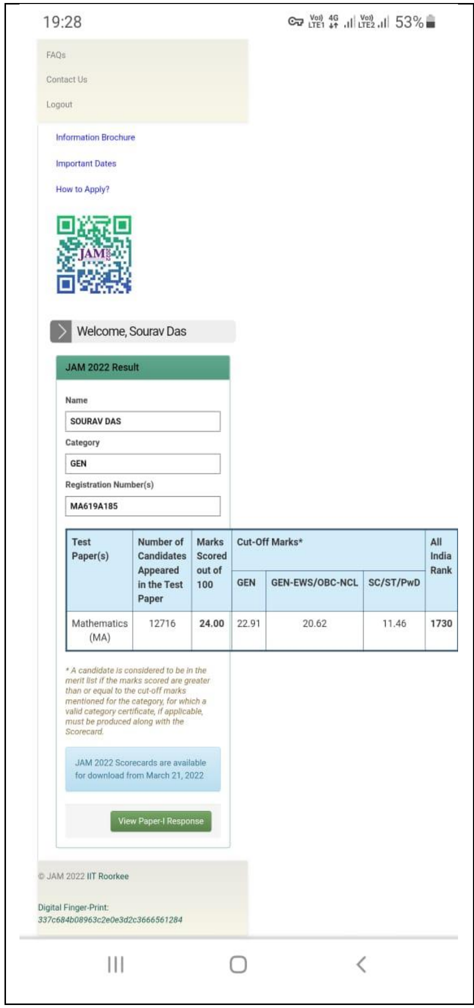
Mathematics (MA)

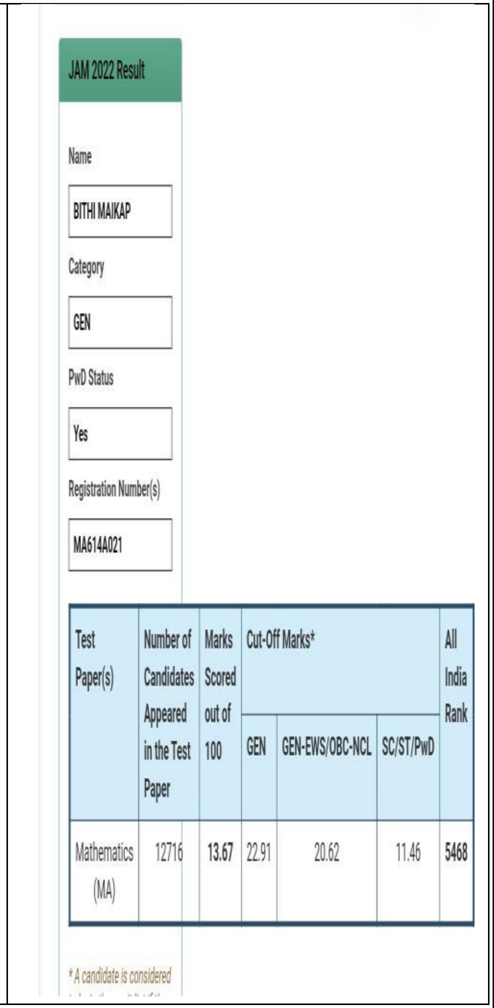
Marks out of 100# 36.33

All India Rank in this 611

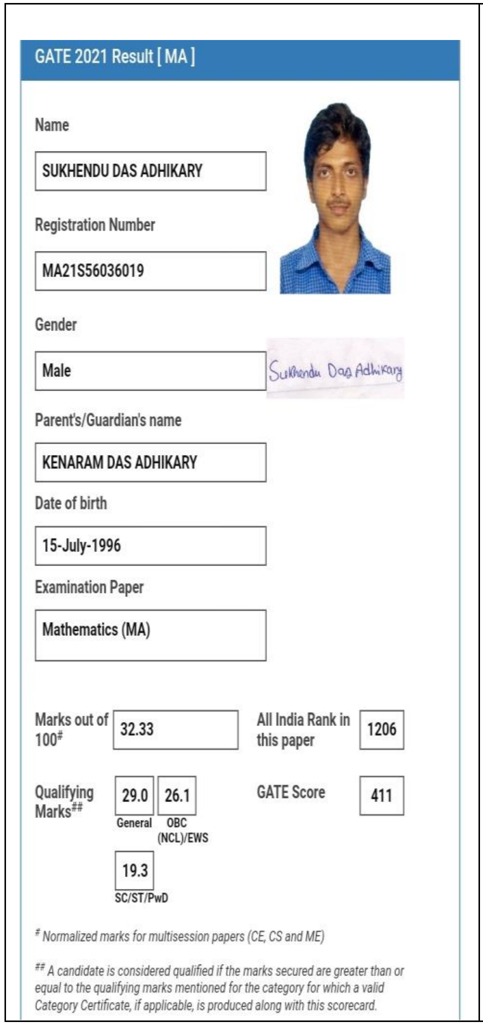
Students Success Record (2020-2022)







Students Success Record (2020-2022)



GATE 2021 Result [MA]

Name

SUKHENDU DAS ADHIKARY

Registration Number

MA21S56036019

Gender

Male

Parent's/Guardian's name

KENARAM DAS ADHIKARY

Date of birth

15-July-1996

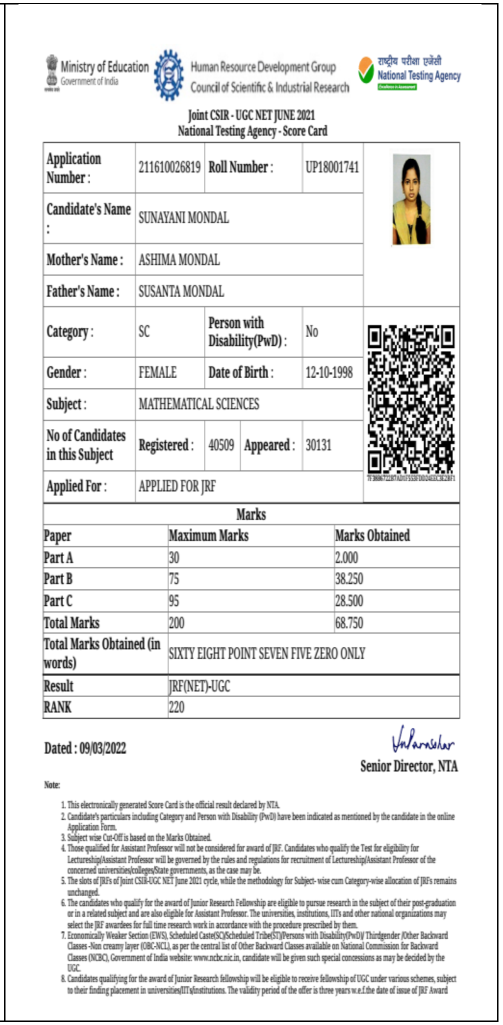
Examination Paper

Mathematics (MA)

Marks out of 100#	32.33	All India Rank in this paper	1206
Qualifying Marks##	29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)	GATE Score	411

 # Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.



Ministry of Education, Government of India — Human Resource Development Group, Council of Scientific & Industrial Research — National Testing Agency

Joint CSIR - UGC NET JUNE 2021
National Testing Agency - Score Card

Application Number :	211610026819	Roll Number :	UP18001741
Candidate's Name :	SUNAYANI MONDAL		
Mother's Name :	ASHIMA MONDAL		
Father's Name :	SUSANTA MONDAL		
Category :	SC	Person with Disability(PwD) :	No
Gender :	FEMALE	Date of Birth :	12-10-1998
Subject :	MATHEMATICAL SCIENCES		
No of Candidates in this Subject	Registered : 40509	Appeared : 30131	
Applied For :	APPLIED FOR JRF		

Marks

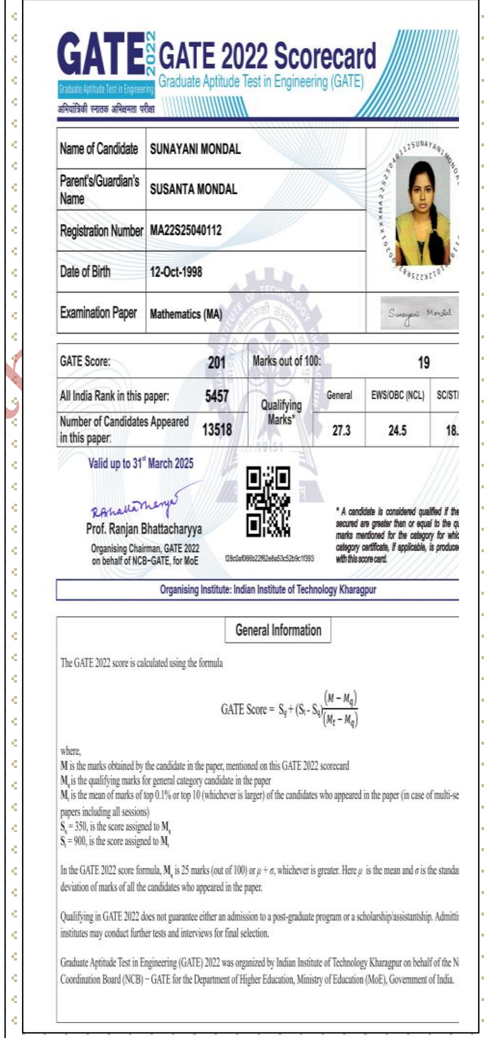
Paper	Maximum Marks	Marks Obtained
Part A	30	2.000
Part B	75	38.250
Part C	95	28.500
Total Marks	200	68.750
Total Marks Obtained (in words)	SIXTY EIGHT POINT SEVEN FIVE ZERO ONLY	
Result	JRF(NET)-UGC	
RANK	220	

Dated : 09/03/2022

Senior Director, NTA

Note:

1. This electronically generated Score Card is the official result declared by NTA.
2. Candidate's particulars including Category and Person with Disability (PwD) have been indicated as mentioned by the candidate in the online Application Form.
3. Subject wise Cut-Off is based on the Marks Obtained.
4. Those qualified for Assistant Professor will not be considered for award of JRF. Candidates who qualify the Test for eligibility for Lectureship/Assistant Professor will be governed by the rules and regulations for recruitment of Lectureship/Assistant Professor of the concerned universities/colleges/State governments, as the case may be.
5. The slots of JRFs of Joint CSIR-UGC NET June 2021 cycle, while the methodology for Subject- wise cum Category-wise allocation of JRFs remains unchanged.
6. The candidates who qualify for the award of Junior Research Fellowship are eligible to pursue research in the subject of their post-graduation or in a related subject and are also eligible for Assistant Professor. The universities, institutions, IITs and other national organizations may select the JRF awardees for full time research work in accordance with the procedure prescribed by them.
7. Economically Weaker Section (EWS), Scheduled Caste(SC)/Scheduled Tribe(ST)/Persons with Disability(PwD)/ Thirdgender /Other Backward Classes -Non creamy layer (OBC-NCL), as per the central list of Other Backward Classes available on National Commission for Backward Classes (NCBC), Government of India website: www.ncbc.nic.in, candidate will be given such special concessions as may be decided by the UGC.
8. Candidates qualifying for the award of Junior Research fellowship will be eligible to receive fellowship of UGC under various schemes, subject to their finding placement in universities/IITs/institutions. The validity period of the offer is three years w.e.f.the date of issue of JRF Award



GATE 2022 GATE 2022 Scorecard
Graduate Aptitude Test in Engineering (GATE)

Name of Candidate	SUNAYANI MONDAL
Parent's/Guardian's Name	SUSANTA MONDAL
Registration Number	MA22S25040112
Date of Birth	12-Oct-1998
Examination Paper	Mathematics (MA)

GATE Score:	201	Marks out of 100:	19		
All India Rank in this paper:	5457	Qualifying Marks*	General	EWS/OBC (NCL)	SC/ST/
Number of Candidates Appeared in this paper:	13518		27.3	24.5	18.

Valid up to 31st March 2025

Prof. Ranjan Bhattacharyya
Organising Chairman, GATE 2022
on behalf of NCB-GATE, for MoE

* A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid category certificate, if applicable, is produced with this score card.

Organising Institute: Indian Institute of Technology Kharagpur

General Information

The GATE 2022 score is calculated using the formula

$$\text{GATE Score} = S_q + (S_t - S_q)\frac{(M - M_q)}{(M_t - M_q)}$$

where,
M is the marks obtained by the candidate in the paper, mentioned on this GATE 2022 scorecard
M_q is the qualifying marks for general category candidate in the paper
M_t is the mean of marks of top 0.1% or top 10 (whichever is larger) of the candidates who appeared in the paper (in case of multi-se papers including all sessions)
S_q = 350, is the score assigned to M_q
S_t = 900, is the score assigned to M_t

In the GATE 2022 score formula, M_q is 25 marks (out of 100) or $\mu + \sigma$, whichever is greater. Here μ is the mean and σ is the standa deviation of marks of all the candidates who appeared in the paper.

Qualifying in GATE 2022 does not guarantee either an admission to a post-graduate program or a scholarship/assistantship. Admitti institutes may conduct further tests and interviews for final selection.

Graduate Aptitude Test in Engineering (GATE) 2022 was organized by Indian Institute of Technology Kharagpur on behalf of the N Coordination Board (NCB) – GATE for the Department of Higher Education, Ministry of Education (MoE), Government of India.

Students Success Record (2020-2022)

No. of GATE Qualified:07
No. of NET Qualified:02
No. of JAM Qualified:06

Skill Development Course for Scientific Documentation using Latex

MUGBERIA GANGADHAR MAHAVIDYALAYA

Taking Certificate On Completing LATEX

PG 4th SEM Department Of Mathematics

SL NO.	NAME	ROLL	NO.	CLASS	SUBJECT
1	Swarnendu Pradhan	PG/VUEGS32/MTM-IVS	0003	PG 4th Sem	Mathematics
2	Twameka Tripathi	PG/VUEGS32/MTM-IVS	0007	PG 4th Sem	Mathematics
3	Sayani Sinha	PG/VUEGS32/MTM-IVS	0021	PG 4th Sem	Mathematics
4	Kuheli Mandal	PG/VUEGS32/MTM-IVS	0035	PG 4th Sem	Mathematics
5	Srikrishna Nayak	PG/VUEGS32/MTM-IVS	0026	PG 4th Sem	Mathematics
6	Anai Mishra	PG/VUEGS32/MTM-IVS	0028	PG 4th Sem	Mathematics
7	Sayantani Maiti	PG/VUEGS32/MTM-IVS	0038	PG 4th Sem	Mathematics
8	Sanjib Day	PG/VUEGS32/MTM-IVS	0004	PG 4th Sem	Mathematics
9	Subhendu Bhunia	PG/VUEGS32/MTM-IVS	0012	PG 4th Sem	Mathematics
10	Susmita Pal	PG/VUEGS32/MTM-IVS	0022	PG 4th Sem	Mathematics
11	Gouri Shankar Mandal	PG/VUEGS32/MTM-IVS	0018	PG 4th Sem	Mathematics
12	Parthapratim Sahoo	PG/VUEGS32/MTM-IVS	0019	PG 4th Sem	Mathematics
13	Susmita Pahari	PG/VUEGS32/MTM-IVS	0005	PG 4th Sem	Mathematics
14	Moumita Tunga	PG/VUEGS32/MTM-IVS	0011	PG 4th Sem	Mathematics
15	Ananya Pattanayak	PG/VUEGS32/MTM-IVS	0010	PG 4th Sem	Mathematics
16	Saikat Gayen	PG/VUEGS32/MTM-IVS	0029	PG 4th Sem	Mathematics
17	Arup Mondal	PG/VUEGS32/MTM-IVS	0030	PG 4th Sem	Mathematics
18	Biswaranjan Manna	PG/VUEGS32/MTM-IVS	0013	PG 4th Sem	Mathematics
19	Subha Ghorai	PG/VUEGS32/MTM-IVS	0014	PG 4th Sem	Mathematics
20	Anupama Khatua	PG/VUEGS32/MTM-IVS	0009	PG 4th Sem	Mathematics
21	Gurapada Jana	PG/VUEGS32/MTM-IVS	0008	PG 4th Sem	Mathematics
22	Basudev Maity	PG/VUEGS32/MTM-IVS	0027	PG 4th Sem	Mathematics
23	Surya Sekhar Giri	PG/VUEGS32/MTM-IVS	0001	PG 4th Sem	Mathematics
24	Subha Pradhan	PG/VUEGS32/MTM-IVS	0002	PG 4th Sem	Mathematics
25	Udita Sahoo	PG/VUEGS32/MTM-IVS	0036	PG 4th Sem	Mathematics
26	Pritam Nayak	PG/VUEGS32/MTM-IVS	0020	PG 4th Sem	Mathematics
27	Arijit Maity	PG/VUEGS32/MTM-IVS	0037	PG 4th Sem	Mathematics
28	Sk Towkir Alam	PG/VUEGS32/MTM-IVS	0024	PG 4th Sem	Mathematics
29	Sougata Bera	PG/VUEGS32/MTM-IVS	0023	PG 4th Sem	Mathematics
30	Shantigopal Jana	PG/VUEGS32/MTM-IVS	0025	PG 4th Sem	Mathematics
31	Harekrishna Maity	PG/VUEGS32/MTM-IVS	0006	PG 4th Sem	Mathematics
32	Supriya Bisai	PG/VUEGS32/MTM-IVS	0016	PG 4th Sem	Mathematics
33	Anasua Maiti	PG/VUEGS32/MTM-IVS	0039	PG 4th Sem	Mathematics
34	Surajit Bhanja	PG/VUEGS32/MTM-IVS	0033	PG 4th Sem	Mathematics
35	Sourav Bera	PG/VUEGS32/MTM-IVS	0032	PG 4th Sem	Mathematics
36	Debasish Pahari	PG/VUEGS32/MTM-IVS	0017	PG 4th Sem	Mathematics
37	Uttam Sen	PG/VUEGS32/MTM-IVS	0015	PG 4th Sem	Mathematics
38	Sangita Das	PG/VUEGS32/MTM-IVS	0031	PG 4th Sem	Mathematics

The Department of Mathematics introduced a "Skill Development Course for Scientific Documentation using Latex" from 2022. In this year the program had been running 15th May – 29th June, 2022. 38 students participated and completed (more than 30 hours) certificate course and they all were received their certificate from the Department on 30th June, 2022. The course helps the students for written their documentations like dissertation, project, lab notebook, field visit report, beamer presentation, etc.

Mugberia Gangadhar Mahavidyalaya

Dept. of Mathematics (U.G & P.G)

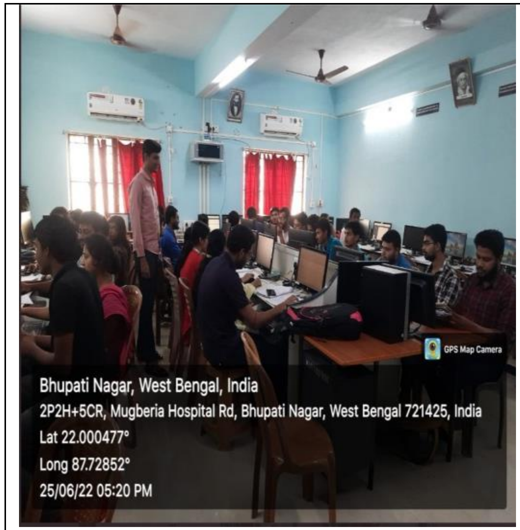
A Certificate Course: Skill Development Course for Scientific Documentation Using Latex

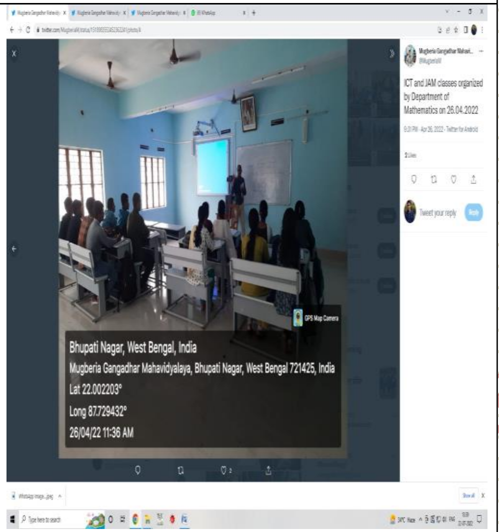
Introduced in 2022

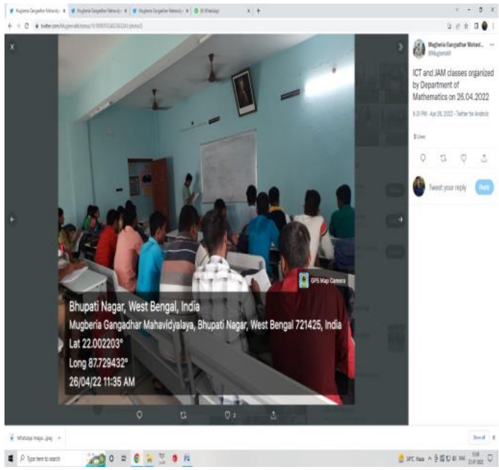
Syllabus for LaTeX (Minimum 30 hours)

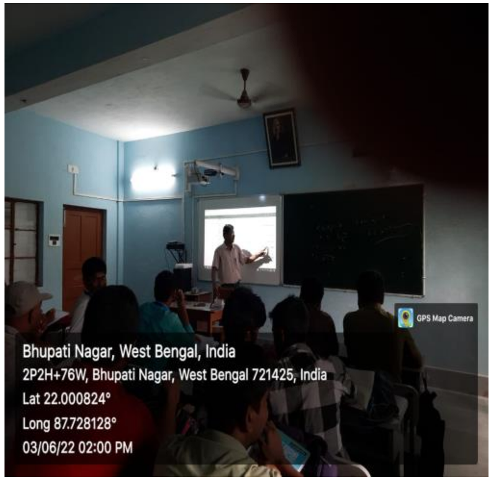
S.NO.	CONTENT	INSTRUCTIONAL HOURS
1	Installation of the software LaTeX.	1
2	Understanding Latex compilation Basic Syntex, Writing equations, Matrix, Tables.	4
3	Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments Table of contents, Generating new commands, Figure handling numbering, List of figures, List of tables, Generating index.	5
4	Packages: Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color, tilez listing and Mathematical Equations.	10
5	Classes: article, book, report, beamer, slides. IEE tran.	4
6	Applications to: Writing Resume , Writing question paper ,Writing articles /research papers, Presentation using beamer.	4
7	Theory, Practical and exercises based on the above concepts.	2

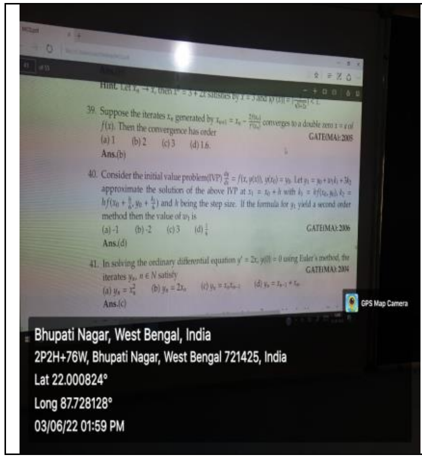
ICT based GATE/NET/JAM Classes (2021-22)

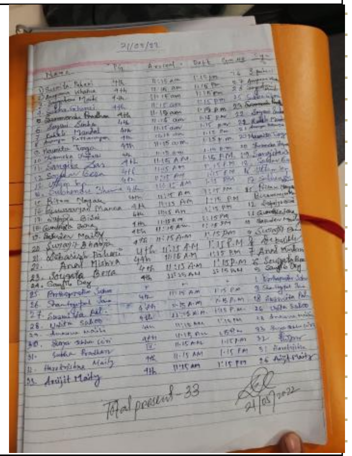












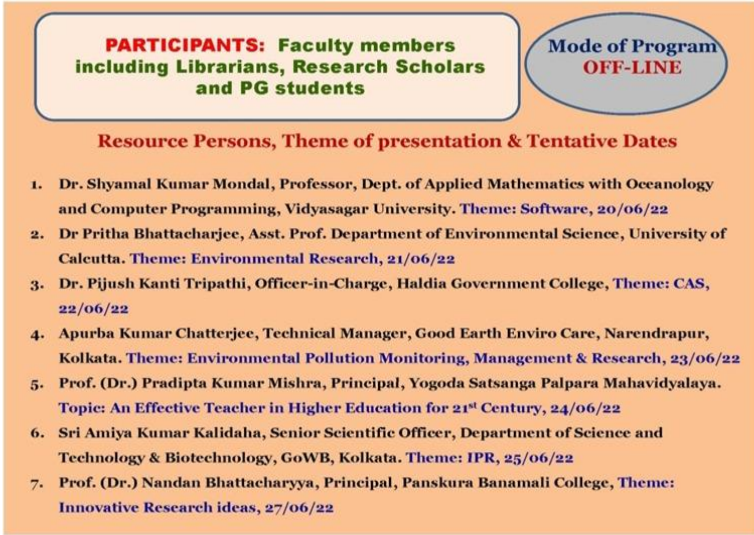
Department of Mathematics is conducting many classes regarding NET/GATE/JAM. Most PG & UG students are participating in these classes.

Group Discussion

Mathematics students are engaged their studies by consulting each other on 02.04.22

Faculty Development Program (20th – 27th June, 2022)

Department of Mathematics



Summer School (15^{th} -24^{th} July, 2021)

LECTURE SCHEDULE OF SUMMER TRAINING SCHOOL

Prof. Kousik Pramanick Professor, Department of Life Science, Presidency University, Kolkata 700073, India. **Title: Species Concept**	**Zoology**	**15.07.2021**	**11AM-1PM**
Dr. Sandip Pal Assistant Professor, Dept. of Zoology, Barrackpore Rastraguru Surendranath College, North 24 Pgs, 700120, India. **Title: The World of Non-Chordates (Theory)**	**Zoology**	**16.07.2021**	**11AM-1PM**
Dr. A.R. Md. Mustafizur Rahaman Assistant Professor, Dept. of Zoology, Asutosh College, Kolkata 700026, India. **Title: Developmental Biology**	**Zoology**	**17.07.2021**	**11AM-1PM**
Dr. Sandip Pal Assistant Professor, Dept. of Zoology, Barrackpore Rastraguru Surendranath College, North 24 Pgs, 700120, India. **Title: The World of Non-Chordates (Practical)**	**Zoology**	**18.07.2021**	**11AM-1PM**
Maidul Hossain Department of Chemistry and Chemical Technology, Vidyasagar University, Paschim Medinipur-721302, West Bengal, India. **Title: "Synthesis of 9-O-(substituted) berberine analogues: Their application towards DNA and protein binding and as a toxic material sensor"**	**Chemistry**	**19.07.2021**	**11AM-1PM**
Prof. Debasis Kuila Professor & Research director, NSF- CREST Bio-energy Center, Department of Chemistry (NSB342), North Carolina A & T State University, USA.	**Chemistry**	**20.07.2021**	**Time will be provided later, preferably at Evening**
Dr. Anupam De Assistant Professor, Department of Applied Science & Humanities. Haldia Institute of Technology, West Bengal. **Title: Role of Mathematics in Modeling and Controlling Pandemic**	**Mathematics**	**21.07.2021**	**11AM-1PM**
Dr Rajarshi Ghosh Associate Professor, Department of Chemistry, The University of Burdwan, Burdwan 713 104, India. **Title: "Magnetic interactions in dinuclear transition metal complexes and prussian blue analogues"**	**Chemistry**	**22.07.2021**	**11AM-1PM**
Dr. Uttam Bera Associate Professor Dept. of Mathematics, NIT Agartala Tripura. **Title: Effect of supply chain during Covid -19**	**Mathematics**	**23.07.2021**	**11AM-1PM**
Dr. Jayanta De Associate Professor, Dept of Mathematics, Mahisadal Raj College, Purba Medinipur, West Bengal. **Title: Role of Mathematics in the present context**	**Mathematics**	**24.07.2021**	**11AM-1PM**

- **Schedule of Examination: 24.07.2021, 1p.m. to 2p.m. (Details will be provided later)**

Department of Mathematics

Three Days International Webinar
On
"Mathematical Modelling In The Context Of Covid-19"

on 30th, 31st August and 1st September, 2020

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

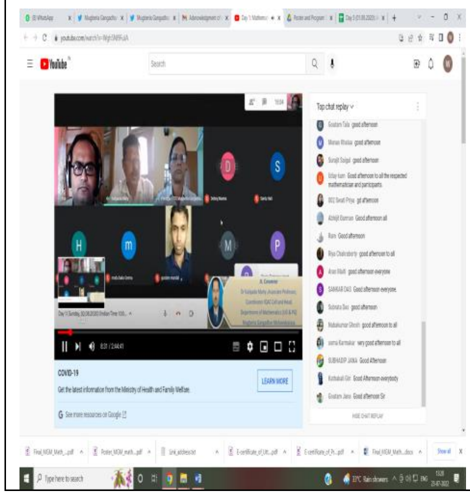
Organised by

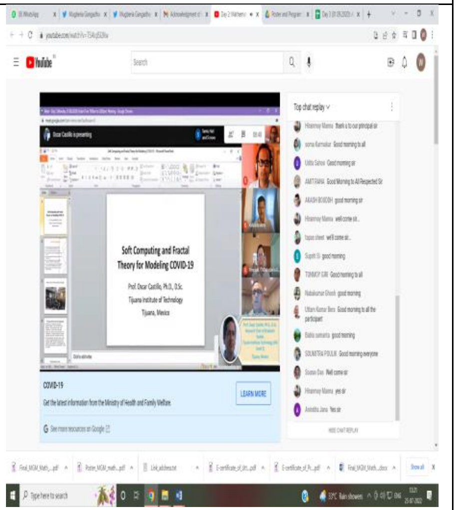
Department of Mathematics (UG & PG)

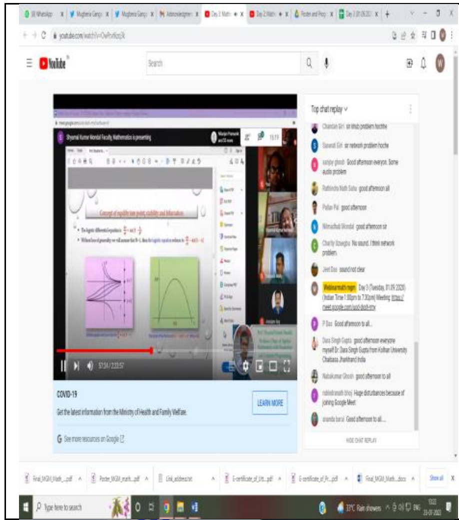
Mugberia Gangadhar Mahavidyalaya

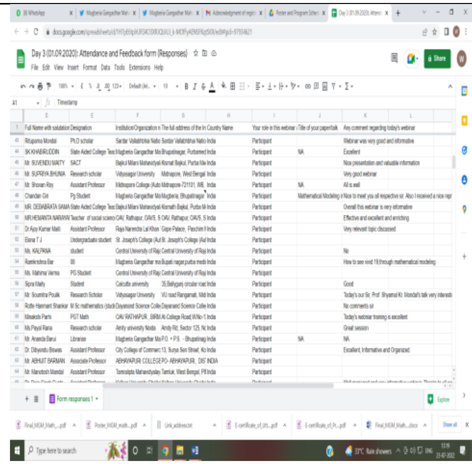
Bhupatinagar, Purba Medinipur – 721425

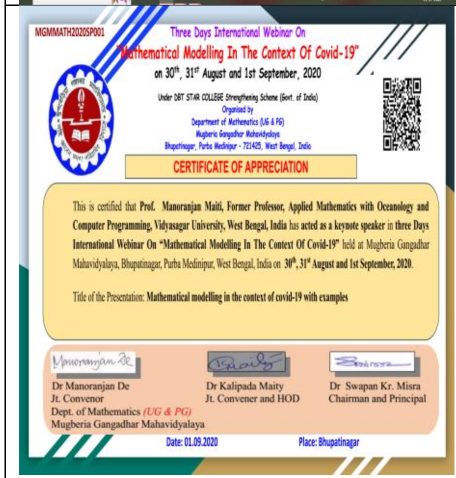
Three Days International Webinar

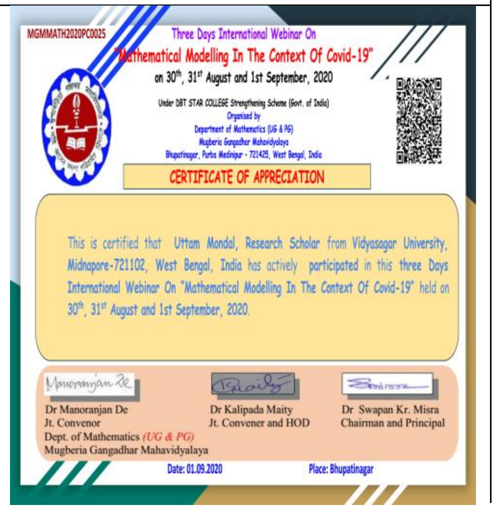












PROGRAMME SCHEDULE

Day 1: 30.08.2020 (Sunday) 3:00 pm to 5:30pm Indian time

Time	Name of the Speaker	Title of the talk	
3:00 pm – 3:15 pm	Dr Kalipada Maity Jt. Convener, Associate Professor, Coordinator IQAC Cell and Head Department of Mathematics (UG & PG) Mugberia Gangadhar Mahavidyalaya	Introductory Remarks & Welcome Address	
3:15 pm – 3:25 pm	Dr Swapan Kumar Misra, Chair Person & Principal Mugberia Gangadhar Mahavidyalaya	Inaugural Speech	
3:25 pm – 4:10 pm	Keynote Address: Prof. Manoranjan Maiti, Former Professor, Dept. of Applied Mathematics with Oceanology and Computer Programming, Vidyasagar University, West Bengal, India.	Mathematical modelling in the context of covid-19 with examples.	
Technical Session -1.1 : Chairman : Prof. Manoranjan Maiti, Former Professor, Dept. of Applied Mathematics, Vidyasagar University,West Bengal, India.			
4:10 pm – 5:00 pm	Speaker 1: Prof. Pankaj Dutta Associate Professor Decision Sciences and Quantitative Methods Shailesh J. Mehta School of Management, I.I.T.Bombay	A multi-objective optimization model for sustainable reverse logistics in E-commerce market.	
5:00 pm – 5:10 pm	Paper Presenter-1: Modu Bako GREMA, Department of Mathematics and Statistics, Ramat Polytechnic Maiduguri, Borno state. Nigeria.	Analytical Solution of Two-dimensional Heat Equation in the Context of Covid 19 using Dirichlet Boundary Condition	
5:10 pm – 5:30 pm		Participant's question and Speaker's reply session	

***********************************End of Day 1**

Day 2: 31.08.2020 (Monday) 8:30 am to 11:30 am Indian time

Technical Session -2.1 : Chairman : Dr. Swapan Kumar Misra, Chairperson & Principal, MGM			
Time	Name of the Speaker	Title of the talk	
8:30 am – 9:20 am	**Speaker-2:** **Prof. Oscar Castillo,** **Ph.D., D.Sc. Research Chair of Graduate Studies Tijuana Institute Technology (SNI Level 3)Tijuana, Mexico**	**Soft Computing and Fractal Theory in Modeling COVID-19 dynamic behavior**	
9:20 am – 10:10 am	**Speaker-3:** **Dr. Dilip Jana** **Manager, Principal Fata Scientist** **Walmart Labs, Dallas, TX, USA**	**Application of Mathematics and Artificial Intelligence to solve COVID-19 related business problems**	
Technical Session -2.2: Chairman: Dr. Manoranjan De, Jt. Convener & Assistant Professor, Dept. of Mathematics (UG&PG), MGM			
10: 20 am – 11:10 am	**Speaker-4:** **Dr. Ram Rup Sarkar** **Senior Principal Scientist** **Chemical engineering and Process Development** **CSIR-National Chemical Laboratory** **Pune, India**	**On the Temporal Analysis of COVID-19 Pandemic and Prediction R**	
11: 10 am – 11:20 am	**Paper Presenter-2:** **Durbar Maji** **Department of Applied Mathematics** **with Oceanology and Computer Programming,** **Vidyasagar University, Midnapore - 721102, India**	**Exact Formulae of The Third Leap Zagreb Index for Some Graph Operations.**	
11:20 am – 11:30 am		**Participant's question and Speaker's reply session**	

End of Day 2

Day 3: 01.09.2020 (Tuesday) 3:00 pm to 5:30pm Indian time

Technical Session -3.1: Chairman: Prof. Samarjit Kar, Dept of Mathematics, National Institute of Technology Durgapur West Bengal, India			
Time	Name of the Speaker	Title of the talk	
3:00 pm – 3:50 pm	**Speaker-5:** **Prof. Shyamal Kumar Mandal,** **Professor, Dept. of Applied Mathematics with Oceanology and Computer Programming,** **Vidyasagar University, West Bengal, India.**	**Nobility of Mathematics in analyzing the insights of infectious diseases like COVID-19**	
Technical Session -3.2: Chairman: Prof. Shyamal Kumar Mandal, Professor, Dept. of Applied Mathematics with Oceanology and Computer Programming, Vidyasagar University, West Bengal, India.			
3:50 pm – 4:40 pm	**Speaker-6:** **Prof. Samarjit Kar, Professor, Dept of Mathematics** **National Institute of Technology, Durgapur West Bengal, India**	**Fuzzy based infectious disease modeling for SARS-CoV-2**	
Technical Session -3.3: Chairman: Dr. Kalipada Maity, Jt. Convener & Assistant Professor, Dept. of Mathematics(UG&PG), MGM, West Bengal, India.			
4:40 pm – 4:50 pm	**Paper Presenter-3: Dr. Anjana Bhattacharyya,** **Assistant Professor of Mathematics,** **Victoria Institution (College), Kolkata, India**	**A New Type of Separation Axiom by p*-Closure Operator in Fuzzy Setting**	
4:50 pm – 5:00 pm	**Paper Presenter-4: Dr Bablu Samanta** **Assistant Professor & HOD** **Dept. of Mathematics Egra SSB College** **Puba Medinipur,west Bengal, INDIA**	**Uncertainty based multi-objective portfolio selection model**	
5:00 pm – 5:20 pm		**Participant's question and Speaker's reply session**	
5:20 pm – 5:30 pm	**Dr Manoranjan De** **Jt. Convener, Assistant Professor** **Department of Mathematics (UG & PG)** **Mugberia Gangadhar Mahavidyalaya**	**Vote of Thanks and End of the Webinar**	

***********************************End of Day 3***

Report on Competitive Examinations and Career Counselling offered by the Mathematics Department during July 2018 -2023

Mugberia Gangadhar Mahavidyalaya

The Department of Mathematics arranged various types of workshop and ICT based class for GATE/ NET/JAM/Competitive Examination during every academic year. In the departmental routine, the teachers take the classess as per routine. Most of students are much more interest about the class and many student are qualifyed in NET/GATE/JAM/CAT/CTET/TET and others examinations. Several programme and activities are listed below:

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/08/2018

Minutes of the Departmental meeting held on 18.08.2019

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof.

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact. (Jt. Co-oridinator)

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. Goutam Mandal, Contractual teacher (Coordinator)

(8) Mr. SantuHati, Contractual teacher.

A short meeting was arranged at 3:15 pm regarding the Two Days Workshop on NET, GATE, NBHM& TFIR syllabus in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Goutam Mandal will be the coordinator of this program and Mr. Bikash Ponda will be program jt. Co-ordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 25 August, 2018 to 26 August 2018

(3) The participation students will be UG-5th Sem,and PG-1st & 3rd sem.

(3) Course content for the said program is scheduled as

(i) Help to choose the right career Help to provide expert resources

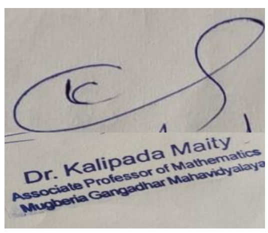
(ii)Help to gain confidence and insight Help to change unwanted behaviour pattern

(iii) Help to reduce career related frustrations

(iv)Help to provide a role model Help to bring stability in thought process

It is decided that the course will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23thAugust 2018. HoD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

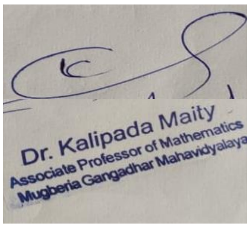


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 20/08/2018

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" from 25th August, 2019 to 26th August 2019 in our department through online mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23rd August 2019. All the students of our college especially of our dept. are requested to be present in this course.



Two Days Workshop on NET, GATE, NBHM& TFIR syllabus

Date: 25.08.2018

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation; Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART ‘B’ AND ‘C’ MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy’s theorem, Cauchy’s integral formula, Liouville’s theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese

Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Speaker: Dr. Manoran De, Assistant Professor, dept of Mathematics

Date: 26.08.2018

Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

a. NBHM Syllabus in Mathematics

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

Section B: Analysis Real Analysis: Sequence and limits, Series, Matric Spaces, Functional Analysis Maxima and minima Continues functionDefining a function Differential function Complex Analysis Poles and Residues Polar coordinates.

Section C: Geometric : Algebraic geometry Cartesian coordinates Polar coordinates Plane algebraic curves Cubic curves Lines Circles 3d Shapes Ellipse Elliptical curves etc.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations, characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Rieman integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log, trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.

Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
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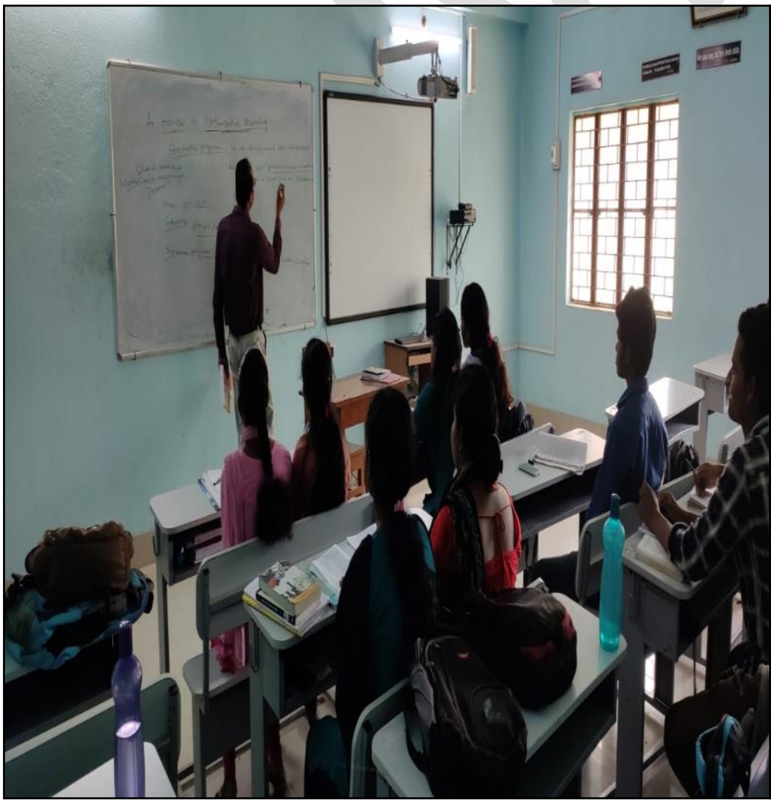
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington



Registration

S.N.	Name	UG/PG
1	CHANDAN GIRI	PG
2	CHAYAN PRADHAN	PG
3	DEBOTTAM JANA	PG
4	DIBYAYAN JANA	PG
5	GOPAL DAS	PG
6	MANISH ACHARYYA	PG
7	MOUMITA SAHOO	PG
8	AMIT MANDAL	PG
9	ANKITA SAMANTA	PG
10	ASHARANI MANNA	PG
11	BISWAJIT PATRA	PG
12	MADHUSHREE SAHU	PG
13	MANAS BERA	PG
14	MOUMITA PRADHAN	PG
15	NANDAN MAITY	PG
16	PURNENDU MONDAL	PG
17	SAGNIK MAIKAP	PG
18	SAPTASREE BHATTACHARYA	PG
19	SUJOY KUMAR MANDAL	PG
20	SUMAN KALYAN DAS	PG
21	SWAPAN MAITY	PG
22	TANUSRI ROY	PG
23	GURUPADA JANA	PG
24	SAIKAT PRAMANIK	PG
25	AMITAVA PATRA	PG
26	CHANDAN GIRI	PG
27	CHAYAN PRADHAN	PG
28	DEBOTTAM JANA	PG
29	DIBYAYAN JANA	PG
30	GOPAL DAS	PG
31	MANISH ACHARYYA	PG
32	MOUMITA SAHOO	PG
33	AMIT MANDAL	PG
34	ANKITA SAMANTA	UG

Registration

S.N.	Student Name	UG/PG
1	AnasuaMaiti	UG
2	AnupamaOjha	UG
3	AnuradhaSau	UG
4	ArijitMaity	UG
5	BarunBera	UG
6	BasudevMaity	UG
7	Bhagyashree Jana	UG
8	Biswaranjan Manna	UG
9	MoumitaBhunia	UG
10	MoumitaMaity	UG
11	PiuMaity	UG
12	PritamNayak	UG
13	PritiChanda	UG
14	Puspita Jana	UG
15	Sabyasachi Mandal	UG
16	Sangita Das	UG
17	Sayani Roy	UG
18	Soumendu Nanda	UG
19	SouravBera	UG
20	Srikrishna Das	UG
21	SubhaGhorai	UG
22	SubhajitSahoo	UG
23	SubhenduBhunia	UG

Registration

S.N.	Student Name	UG/PG
1	AdipMaity	UG
2	Arnab Maity	UG
3	Buddhadev Jana	UG
4	Goutam Jana	UG
5	Kallol Jana	UG
6	MrinmayMahapatra	UG
7	Parag Mandal	UG
8	PoushaliTripathy	UG
9	Prasenjit Mandal	UG
10	Priti Das Adhikari	UG
11	PuspenduSau	UG
12	RathinSamanta	UG
13	RathindranathSahu	UG
14	SahebBera	UG
15	Santu Pradhan	UG
16	Shrabani Jana	UG
17	ShyamalBera	UG
18	Sreya Jana	UG
19	SrikrishnaMaity	UG
20	SubhaBhunia	UG
21	SubhadipSahoo	UG
22	SubinoyPatra	UG
23	SuchismitakPradhan	UG

Five Days Workshop for Problem & Year Wise Questions Paper Solved:

Duration: 2th January- 6th January, 2019

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Day-1:

Topic : Linear Algebra, Real Analysis,

Speaker: Bikash panda, SACT, Dept of Mathematics

Day-2 :

Topic : Linear Programming, Complex Analysis, Calculus

Speaker :Santu Hati, Contractual Teacher, Dept. of Mathematics

Day-3:

Topic: Algebra, Functional Analysis, Numerical Analysis, Topology

Speaker: Hironmay Manna, SACT, Dept. of Mathematics

Day-4:

Topic: ODEs, PDEs, Linear Integral Equation, Classical Mechanics

Speaker: Dr. Kalipada Maity, Associate Professor & HOD Dept. of Mathematics

Day-5:

Topic: Vector Algebra, Calculus of variation, Probability & statistics

Speaker: Dr. Manoranjon De, Assistant Professor, Dept. of Mathematics

Date: 02.01.2019

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Bikash Panda, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

Date: 03.01.2019

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing ‘**Year wise questions paper solve**’ in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Santu Hati, Teacher, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

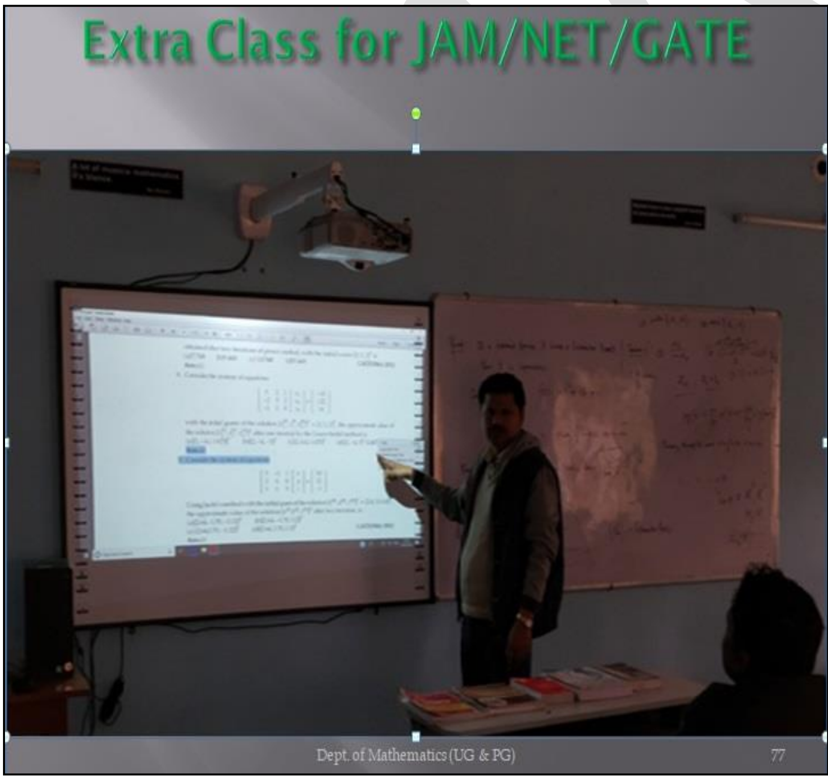
Date: 04.01.2019

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Hiranmoy Mannna, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

Date: 05.01.2019

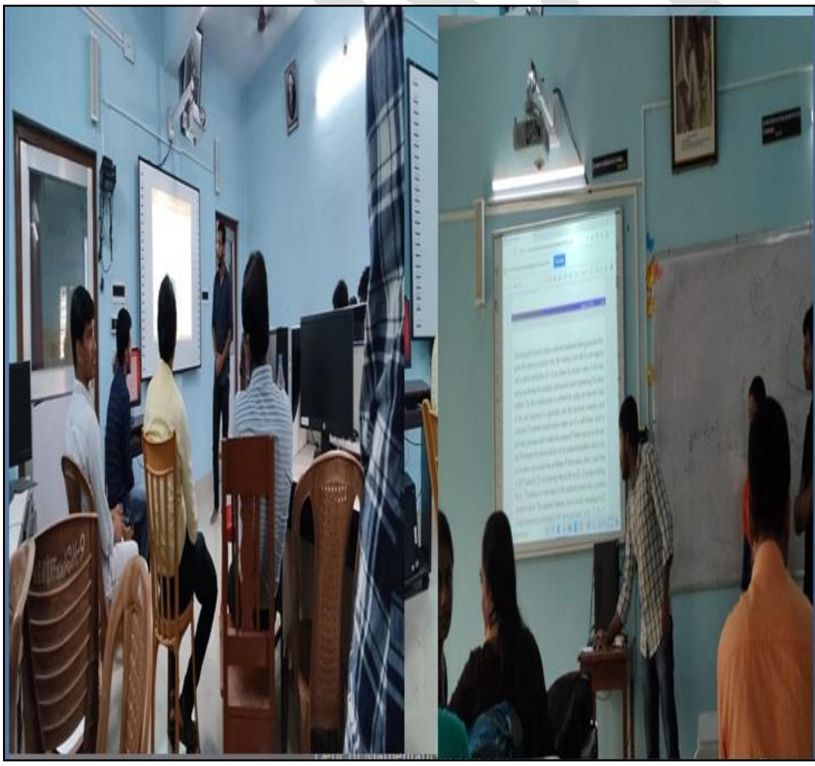
Dr. Kalipada Maity, joint Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Partial Differential Equation field. All in all, the day’s program was a grand success.



Date: 07.01.2022

Date: 06.01.2019

Dr. Manoranjan De, Assistant Professor, Mathematics Department give a ppt presentation in Vector calculus, probality and statistics field. All in all, the day’s program was a grand success.



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15	Santu Pradhan	UG
16	Shrabani Jana	UG
17	ShyamalBera	UG
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21	SubhadipSahoo	UG
22	SubinoyPatra	UG
23	SuchismitakPradhan	UG

Report
Of
Workshop on NET, GATE, NBHM & TFIR syllabus with Problem & Year Wise Questions Paper Solved

Course period: 25th August- 26nd August, 2019
4th January-8th January, 2020

Organized
by
NSS Units of Mugberia Gangadhar Mahavidyalaya
Participated
by

Department of Mathematics (UG & PG)

(**In collaboration with DBT STAR College strengthening Scheme (Govt. of India)**)

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^{+}

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

NOTICE

Dated: 18/08/2019

Minutes of the Departmental meeting held on 18.08.2019

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof.

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact. (Jt. Co-oridinator)

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. Goutam Mandal, Contractual teacher (Coordinator)

(8) Mr. SantuHati, Contractual teacher.

A short meeting was arranged at 3:15 pm regarding the Two Days Workshop on NET, GATE, NBHM& TFIR syllabus in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Goutam Mandal will be the coordinator of this program and Mr. Bikash Ponda will be program jt. Co-ordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 25 August, 2019 to 26 August 2019

(3) The participation students will be UG-5th Sem,and PG-1st & 3rd sem.

(3) Course content for the said program is scheduled as

(i) Help to choose the right career Help to provide expert resources

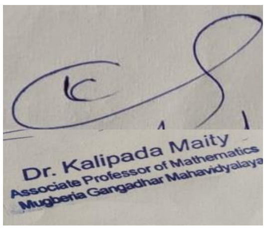
(ii)Help to gain confidence and insight Help to change unwanted behaviour pattern

(iii) Help to reduce career related frustrations

(iv)Help to provide a role model Help to bring stability in thought process

It is decided that the course will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23thAugust 2019. HoD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

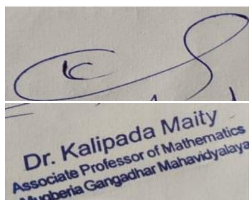


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 20/08/2020

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" from 25th August, 2019 to 26th August 2019 in our department through online mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23rd August 2019. All the students of our college especially of our dept. are requested to be present in this course.



Two Days Workshop on NET, GATE, NBHM& TFIR syllabus

Date: 25.08.2019

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville

eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation; Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART 'B' AND 'C' MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's

theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests,

likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Date: 26.08.2019

Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

a. NBHM Syllabus in Mathematics

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

Section B: Analysis Real Analysis: Sequence and limits, Series, Matric Spaces, Functional Analysis Maxima and minima Continues functionDefining a function Differential function Complex Analysis Poles and Residues Polar coordinates.

Section C: Geometric : Algebraic geometry Cartesian coordinates Polar coordinates Plane algebraic curves Cubic curves Lines Circles 3d Shapes Ellipse Elliptical curves etc.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
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6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations, characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Riemann integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log,

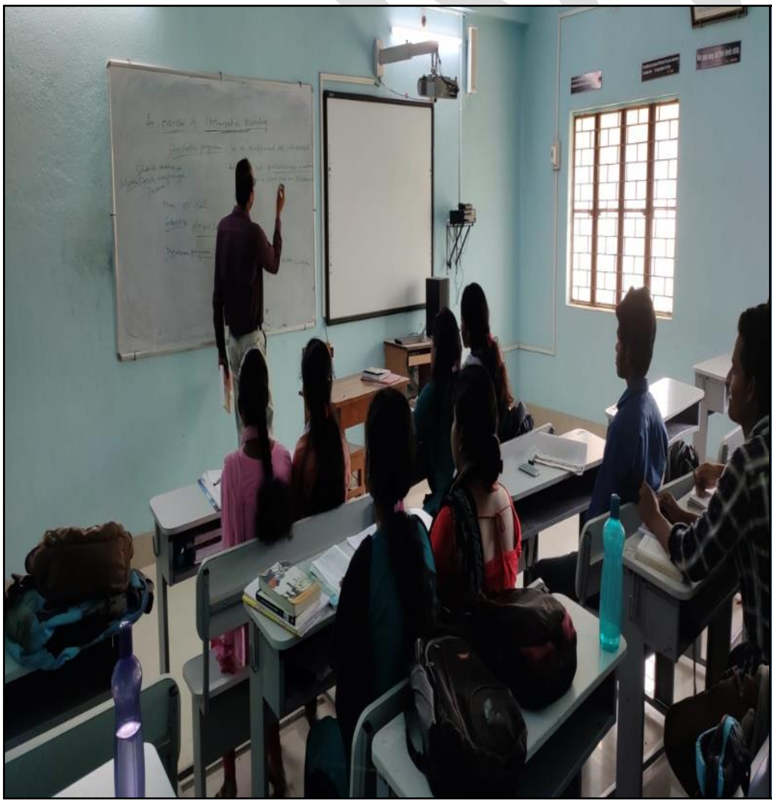
trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.

Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington




Registration

S.N.	Student Name	UG/PG
1	ANSAR ALI KHAN	PG
2	ASHARANI MANNA	PG
3	BIDHAN CHANDRA JANA	PG
4	CHANDAN GIRI	PG
5	CHAYAN PRADHAN	PG
6	DEBMALYA MISHRA	PG
7	DURGA MANDAL	PG
8	GAYATRI JANA	PG
9	GOPAL DAS	PG
10	GOURANGA BERA	PG
11	MADHURI BERA	PG
12	MADHUSUDAN MIDYA	PG
13	MANISH ACHARYYA	PG
14	MOUMITA SAHOO	PG
15	NILANJAN PRAMANIK	PG
16	PALLABITA MAITY	PG
17	RAMNARAYAN PATRA	PG
18	RANITA GIRI	PG
19	SANGITA PAUL	PG
20	SANJU SINGHA	PG
21	SATYAKI ADAK	PG
22	SEULI DEY	PG
23	SIMA BHUNIA	PG
24	SK SAJAHAN	PG
25	SOUMIK HAIT	PG
26	SUDIPTA KHATUA	PG
27	SUMAN MANNA	PG
28	SUPRITI SI	PG

Registration

S.N.	Student Name	UG/PG
1	ANWESHA SAMANTA	UG
2	BITHI MAIKAP	UG
3	DEBRAJ MONDAL	UG
4	DIPAK PARIA	UG
5	INDRANI DAS	UG
6	MANOJ MAITY	UG
7	MEGHA SANTRA	UG
8	NANDITA JANA	UG
9	PABITRA MONDAL	UG
10	PARTHA PRATIM MAITY	UG
11	PRADIP MAITY	UG
12	PUSPENDU MAITY	UG
13	RANJIT PRADHAN	UG
14	SABYASACHI MAJI	UG
15	SAMIK DAS	UG
16	SANTU BERA	UG
17	SASWATI GIRI	UG
18	SOURAV DAS	UG
19	SOURAV TRIPATHY	UG
20	SRIJAN DAS	UG
21	SUBHADIOP JANA	UG
22	SUBHAJIT JANA	UG
23	SURJADIP BARIK	UG

Five Days Workshop for Problem & Year Wise Questions Paper Solved:

Duration: 2^{th} January- 6^{th} January, 2020

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Day-1:

Topic : Linear Algebra, Real Analysis,

Speaker: Bikash panda, SACT, Dept of Mathematics

Day-2 :

Topic : Linear Programming, Complex Analysis, Calculus

Speaker :Santu Hati, Contractual Teacher, Dept. of Mathematics

Day-3:

Topic: Algebra, Functional Analysis, Numerical Analysis, Topology

Speaker: Hironmay Manna, SACT, Dept. of Mathematics

Day-4:

Topic: ODEs, PDEs, Linear Integral Equation, Classical Mechanics

Speaker: Dr. Kalipada Maity, Associate Professor & HOD Dept. of Mathematics

Day-5:

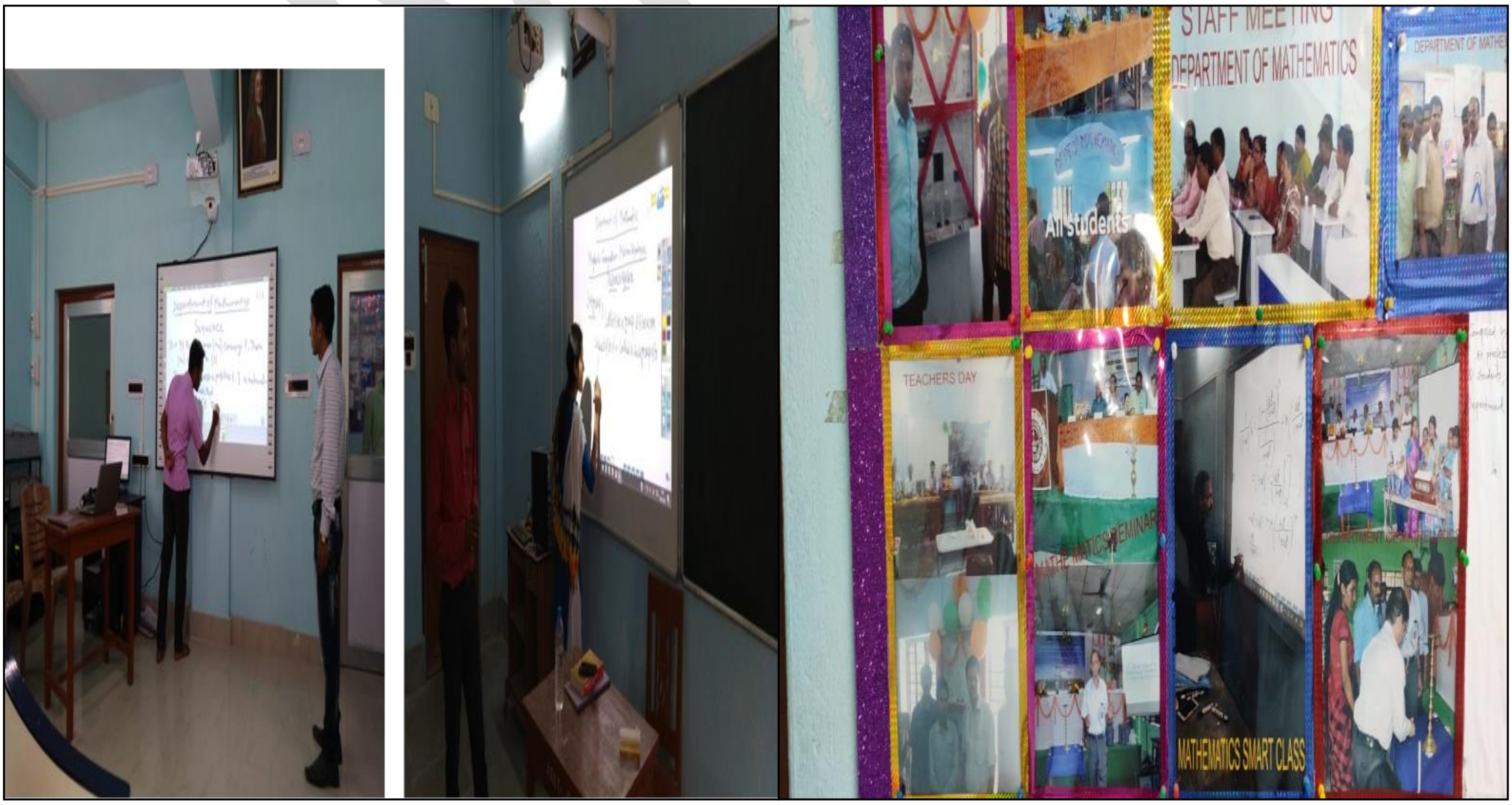
Topic: Vector Algebra, Calculus of variation, Probability & statistics

Speaker: Dr. Manoranjon De, Assistant Professor, Dept. of Mathematics

Date: 02.01.2020

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing ‘**Year wise questions paper solve**’ in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Bikash Panda, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.



Date: 03.01.2020

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Santu Hati, Teacher, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

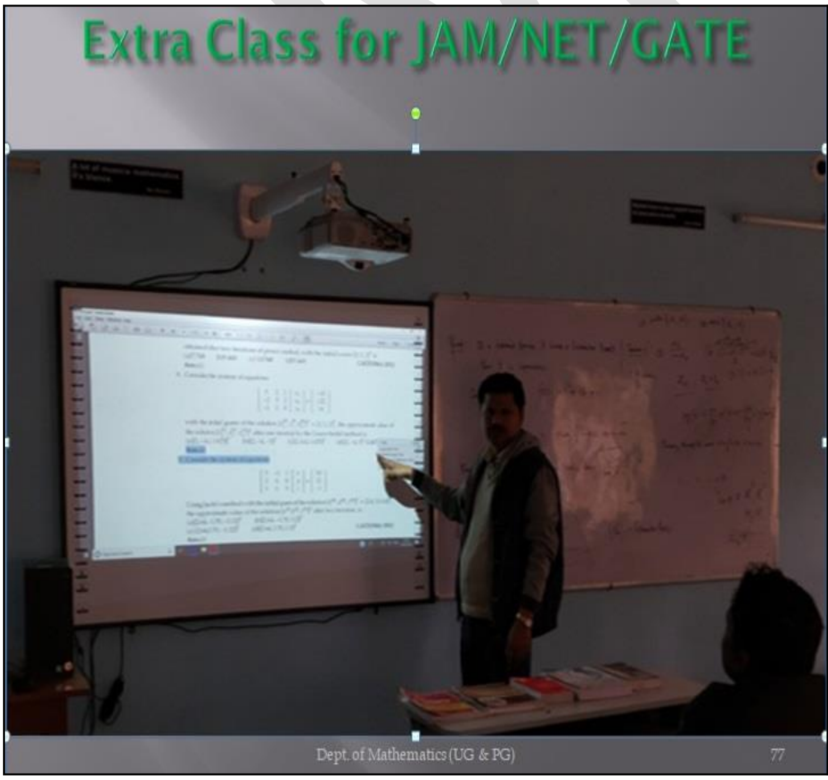
Date: 04.01.2020

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Hiranmoy Mannna, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

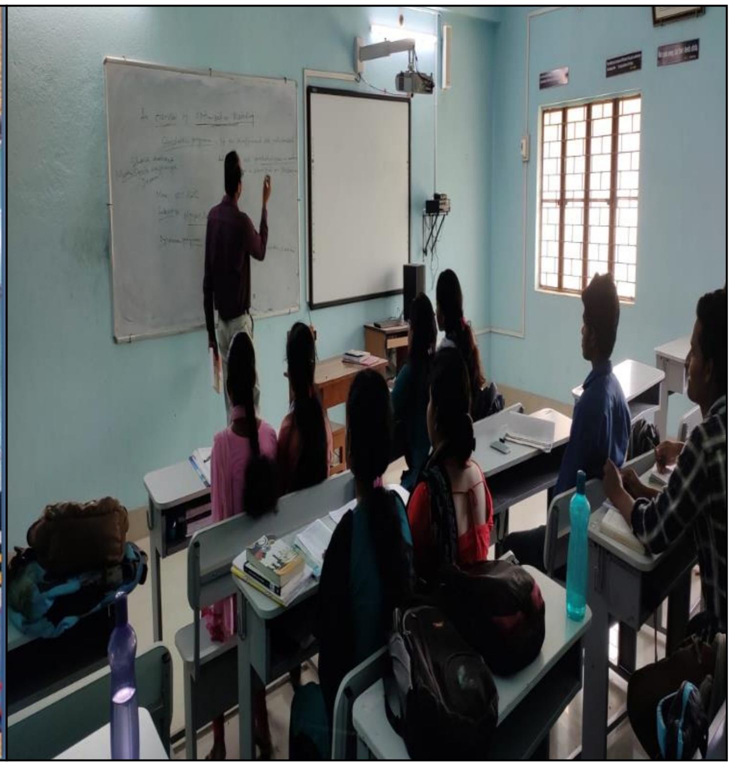
Date: 05.01.2020

Dr. Kalipada Maity, joint Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Partial Differential Equation field. All in all, the day’s program was a grand success.



Date: 06.01.2020

Dr. Manoranjan De, Assistant Professor, Mathematics Department give a ppt presentation in Vector calculus, probality and statistics field. All in all, the day’s program was a grand success.



Registration

S.N.	Student Name	UG/PG
1	ANWESHA SAMANTA	UG
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3	DEBRAJ MONDAL	UG
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5	INDRANI DAS	UG
6	MANOJ MAITY	UG
7	MEGHA SANTRA	UG
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12	PUSPENDU MAITY	UG
13	RANJIT PRADHAN	UG
14	SABYASACHI MAJI	UG
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16	SANTU BERA	UG
17	SASWATI GIRI	UG
18	SOURAV DAS	UG
19	SOURAV TRIPATHY	UG
20	SRIJAN DAS	UG
21	SUBHADIOP JANA	UG
22	SUBHAJIT JANA	UG
23	SURJADIP BARIK	UG

List of GATE qualifying students in the session 2021-22

1. SUKHENDU DAS ADHIKARY (PG-2019)
2. Rabindranath Bhoj (PG-2019)
3. Manish Acharyya (PG-2021)
4.

List of GATE qualifying students in the session 2020-21

1. Subhasish Das (PG-2020)
2. Rabindranath Bhoj (PG-2019)
3. Sandip Das (PG-2020)
4. Ramkrishna Bar (PG-2020)
5. Bubun Das (UG)
6. Sukhendu Das Adhikary (PG-2019)
7. SUNAYANI MONDAL (PG-2020)

List of CSIR-NET qualifying students in the session 2021-22

1. SUNAYANI MONDAL (PG-2020)
2. SUKHENDU DAS ADHIKARY(PG-2019)
3. Bubun Das (UG)
4. Rabindranath Bhoj (PG-2019)

Report
Of
Workshop on NET, GATE, NBHM & TFIR syllabus with Problem & Year Wise Questions Paper Solved

Course period: 25th August- 26nd August, 2020
4th January-8th January, 2021

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Organized
by
NSS Units of Mugberia Gangadhar Mahavidyalaya
Participated
by

Department of Mathematics (UG & PG)

(In collaboration with DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^+

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/08/2020

Minutes of the Departmental meeting held on 18.08.2020

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof.

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact. (Jt. Co-oridinator)

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. Goutam Mandal, Contractual teacher (Coordinator)

(8) Mr. SantuHati, Contractual teacher.

A short meeting was arranged at 3:15 pm regarding the Two Days Workshop on NET, GATE, NBHM& TFIR syllabus in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Goutam Mandal will be the coordinator of this program and Mr. Bikash Ponda will be program jt. Co-ordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 25 August, 2020 to 26 August 2020

(3) The participation students will be UG-5th Sem,and PG-1st & 3rd sem.

(3) Course content for the said program is scheduled as

(i) Help to choose the right career Help to provide expert resources

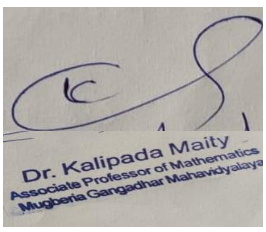
(ii)Help to gain confidence and insight Help to change unwanted behaviour pattern

(iii) Help to reduce career related frustrations

(iv)Help to provide a role model Help to bring stability in thought process

It is decided that the course will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23thAugust 2021. HoD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

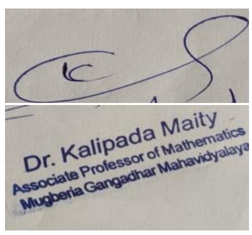


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 20/08/2020

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" from 25thAugust, 2021 to 26th August 2021in our department through online mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23rd August 2021. All the students of our college especially of our dept. are requested to be present in this course.



Two Days Workshop on NET, GATE, NBHM& TFIR syllabus

Date: 25.08.2020

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville

eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation; Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

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4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
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b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART 'B' AND 'C' MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's

theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests,

likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Date: 26.08.2020

Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

a. NBHM Syllabus in Mathematics

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

Section B: Analysis Real Analysis: Sequence and limits, Series, Matric Spaces, Functional Analysis Maxima and minima Continues functionDefining a function Differential function Complex Analysis Poles and Residues Polar coordinates.

Section C: Geometric : Algebraic geometry Cartesian coordinates Polar coordinates Plane algebraic curves Cubic curves Lines Circles 3d Shapes Ellipse Elliptical curves etc.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations, characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Riemann integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log,

trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.

Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Registration

S.N.	Student Name	UG/PG
1	ANSAR ALI KHAN	PG
2	ASHARANI MANNA	PG
3	BIDHAN CHANDRA JANA	PG
4	CHANDAN GIRI	PG
5	CHAYAN PRADHAN	PG
6	DEBMALYA MISHRA	PG
7	DURGA MANDAL	PG
8	GAYATRI JANA	PG
9	GOPAL DAS	PG
10	GOURANGA BERA	PG
11	MADHURI BERA	PG
12	MADHUSUDAN MIDYA	PG
13	MANISH ACHARYYA	PG
14	MOUMITA SAHOO	PG
15	NILANJAN PRAMANIK	PG
16	PALLABITA MAITY	PG
17	RAMNARAYAN PATRA	PG
18	RANITA GIRI	PG
19	SANGITA PAUL	PG
20	SANJU SINGHA	PG
21	SATYAKI ADAK	PG
22	SEULI DEY	PG
23	SIMA BHUNIA	PG
24	SK SAJAHAN	PG
25	SOUMIK HAIT	PG
26	SUDIPTA KHATUA	PG
27	SUMAN MANNA	PG
28	SUPRITI SI	PG
29	TAPAS SHEET	PG
30	TUHINA GIRI	PG
31	ANSAR ALI KHAN	PG
32	ASHARANI MANNA	PG
33	BIDHAN CHANDRA JANA	PG
34	CHANDAN GIRI	UG

Registration

S.N.	Student Name	UG/PG
1	Somsankar Mandal	UG
2	Suman Das	UG
3	AmiyendraMaiti	UG
4	SoumyadeepBej	UG
5	JatindranathSamanta	UG
6	SudiptaMondal	UG
7	Ranajit Mandal	UG
8	AtanuMaity	UG
9	BachaspatiMondal	UG
10	ShubhajitGiri	UG
11	SurajitMaity	UG
12	Ayan Pradhan	UG
13	Rajkumar Karan	UG
14	Soumitra Das	UG
15	BidishaSasmal	UG
16	Sonali Mandal	UG
17	SudeshnaMaity	UG
18	AnneshaKhatua	UG
19	ParamitaMaity	UG
20	Megha Rani Sahoo	UG
21	Gaurangi Pal	UG
22	SubhadipMahapatra	UG
23	Amit Patra	UG

Five Days Workshop for Problem & Year Wise Questions Paper Solved:

Duration: 2th January- 6th January, 2021

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Day-1:

Topic : Linear Algebra, Real Analysis,

Speaker: Bikash panda, SACT, Dept of Mathematics

Day-2 :

Topic : Linear Programming, Complex Analysis, Calculus

Speaker :Santu Hati, Contractual Teacher, Dept. of Mathematics

Day-3:

Topic: Algebra, Functional Analysis, Numerical Analysis, Topology

Speaker: Hironmay Manna, SACT, Dept. of Mathematics

Day-4:

Topic: ODEs, PDEs, Linear Integral Equation, Classical Mechanics

Speaker: Dr. Kalipada Maity, Associate Professor & HOD Dept. of Mathematics

Day-5:

Topic: Vector Algebra, Calculus of variation, Probability & statistics

Speaker: Dr. Manoranjon De, Assistant Professor, Dept. of Mathematics

Date: 02.01.2021

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Bikash Panda, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

Date: 03.01.2021

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Santu Hati, Teacher, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

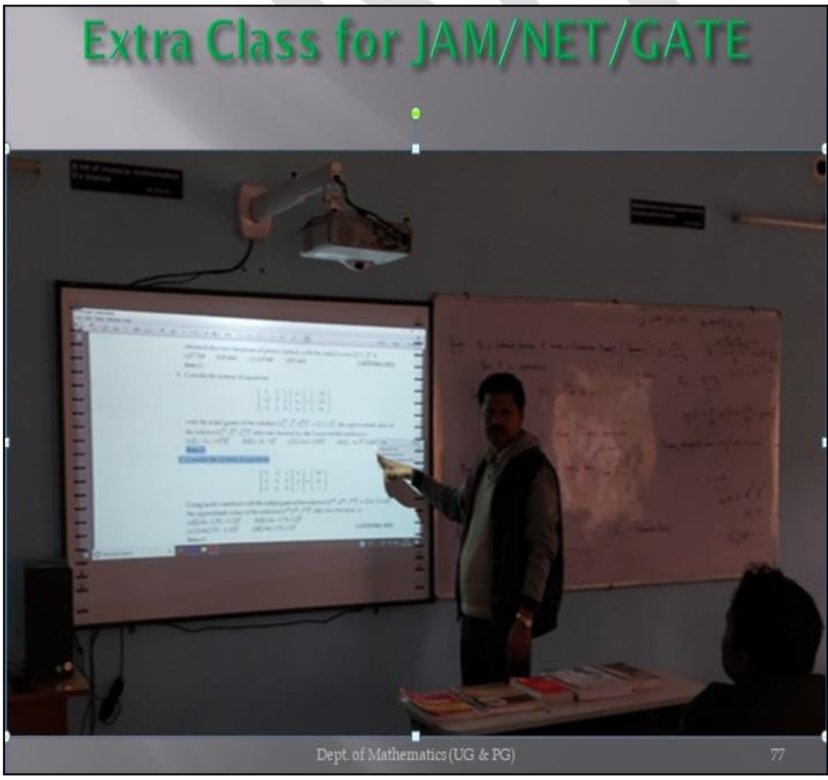
Date: 04.01.2021

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing ‘**Year wise questions paper solve**’ in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Hiranmoy Mannna, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

Date: 05.01.2021

Dr. Kalipada Maity, joint Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Partial Differential Equation field. All in all, the day’s program was a grand success.



Date: 06.01.2021

Dr. Manoranjan De, Assistant Professor, Mathematics Department give a ppt presentation in Vector calculus, probality and statistics field. All in all, the day's program was a grand success.

Registration

S.N.	Student Name	UG/PG
1	Somsankar Mandal	UG
2	Suman Das	UG
3	AmiyendraMaiti	UG
4	SoumyadeepBej	UG
5	JatindranathSamanta	UG
6	SudiptaMondal	UG
7	Ranajit Mandal	UG
8	AtanuMaity	UG
9	BachaspatiMondal	UG
10	ShubhajitGiri	UG
11	SurajitMaity	UG
12	Ayan Pradhan	UG
13	Rajkumar Karan	UG
14	Soumitra Das	UG
15	BidishaSasmal	UG
16	Sonali Mandal	UG
17	SudeshnaMaity	UG
18	AnneshaKhatua	UG
19	ParamitaMaity	UG
20	Megha Rani Sahoo	UG
21	Gaurangi Pal	UG
22	SubhadipMahapatra	UG

23	1. Amit Patra	UG

List of GATE qualifying students in the session 2021-22

1. SUKHENDU DAS ADHIKARY (PG-2019)
2. Rabindranath Bhoj (PG-2019)
3. Manish Acharyya (PG-2021)
4.

List of GATE qualifying students in the session 2020-21

1. Subhasish Das (PG-2020)
2. Rabindranath Bhoj (PG-2019)
3. Sandip Das (PG-2020)
4. Ramkrishna Bar (PG-2020)
5. Bubun Das (UG)
6. Sukhendu Das Adhikary (PG-2019)
7. SUNAYANI MONDAL (PG-2020)

List of CSIR-NET qualifying students in the session 2021-22

1. SUNAYANI MONDAL (PG-2020)
2. SUKHENDU DAS ADHIKARY(PG-2019)
3. Bubun Das (UG)
4. Rabindranath Bhoj (PG-2019)

Report
Of
Five days workshop for Career Counseling in Higher Education

Course period: 29th August- 02nd September, 2022

Organized

by

NSS Units of Mugberia Gangadhar Mahavidyalaya

Participated

by

Department of Mathematics (UG & PG)

(In collaboration with DBT STAR College strengthening Scheme (Govt. of India)

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^{+}

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/08/2021

Minutes of the Departmental meeting held on 18.08.2021

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof.

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact. (Jt. Co-oridinator)

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. Goutam Mandal, Contractual teacher (Coordinator)

(8) Mr. SantuHati, Contractual teacher.

A short meeting was arranged at 3:15 pm regarding the Two Days Workshop on NET, GATE, NBHM& TFIR syllabus in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Goutam Mandal will be the coordinator of this program and Mr. Bikash Ponda will be program jt. Co-ordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 25 August, 2021 to 26 August 2021

(3) The participation students will be UG-5th Sem,and PG-1st & 3rd sem.

(3) Course content for the said program is scheduled as

(i) Help to choose the right career Help to provide expert resources

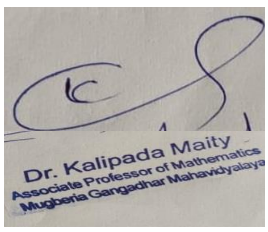
(ii)Help to gain confidence and insight Help to change unwanted behaviour pattern

(iii) Help to reduce career related frustrations

(iv)Help to provide a role model Help to bring stability in thought process

It is decided that the course will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23thAugust 2021. HoD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

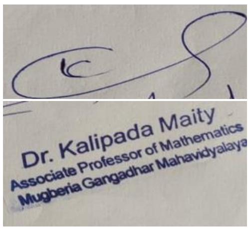


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 20/08/2021

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" from 25th August, 2021 to 26th August 2021in our department through online mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23rd August 2021. All the students of our college especially of our dept. are requested to be present in this course.



Two Days Workshop on NET, GATE, NBHM& TFIR syllabus

Date: 25.08.2021

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville

eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation; Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART 'B' AND 'C' MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's

theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

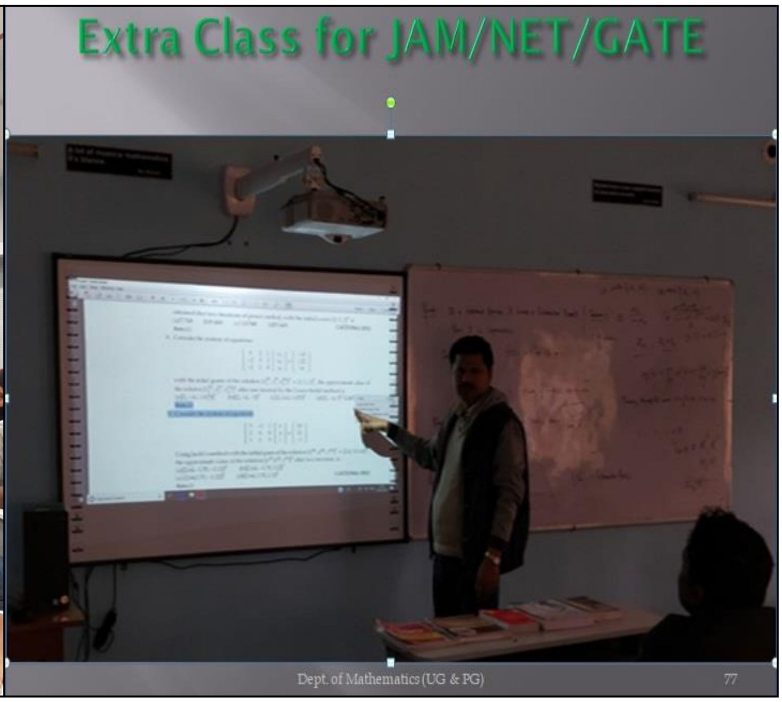
UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests,

likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington



Date: 26.08.2021

Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

a. NBHM Syllabus in Mathematics

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

Section B: Analysis Real Analysis: Sequence and limits, Series, Matric Spaces, Functional Analysis Maxima and minima Continues functionDefining a function Differential function Complex Analysis Poles and Residues Polar coordinates.

Section C: Geometric : Algebraic geometry Cartesian coordinates Polar coordinates Plane algebraic curves Cubic curves Lines Circles 3d Shapes Ellipse Elliptical curves etc.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations, characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Riemann integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log,

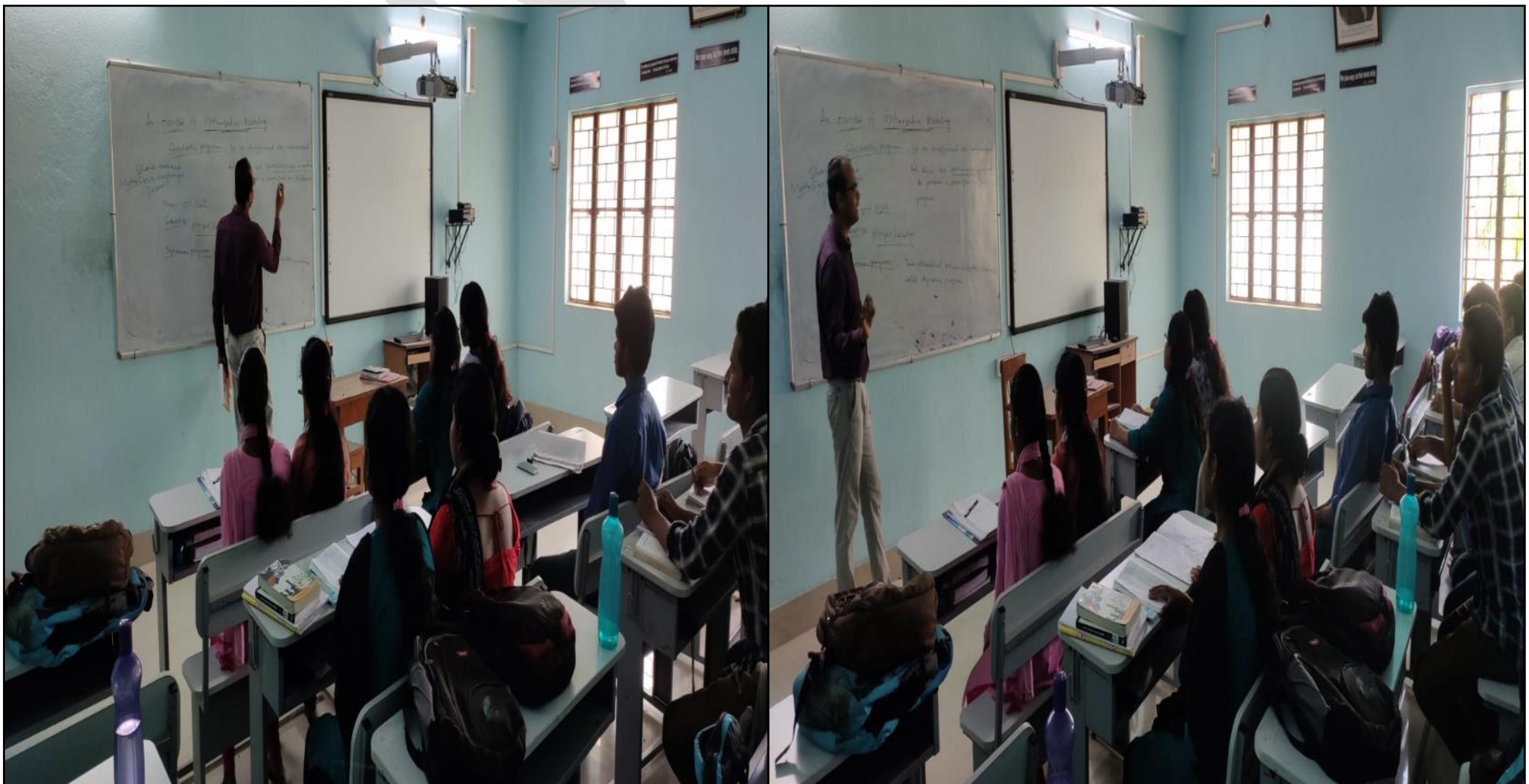
trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.

Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington



Registration

S.N.	Student Name	UG/PG
1	Amiya Mandal	PG
2	Biren Pahari	PG
3	Biswajit Mondal	PG
4	Buddhadev Jana	PG
5	Debabrata Patra	PG
6	Debajyoti Maity	PG
7	Ditangshu Barman	PG
8	Goutam Jana	PG
9	Krishendu Pradhan	PG
10	Moumita Sardar	PG
11	Poushali Tripathy	PG
12	Pradyot Dalapati	PG
13	Priti Das Adhikari	PG
14	Puspendu Sau	PG
15	Raja Kumar Shee	PG
16	Saikat Jana	PG
17	Sachayan Laha	PG
18	Shrabani Jana	PG
19	Shyamal Bera	PG
20	Snehasish Bhowmik	PG
21	Snigdha Mandal	PG
22	Shreya Jana	PG
23	Subhadip Mandal	PG
24	Subhamay Das	PG
25	Subinoy Patra	PG
26	Suchismita Pradhan	PG
27	Sudeshna Maity	PG
28	Susmita Sahoo	PG
29	Tapasi Karan	PG
30	Sahib Bera	PG
31	Soumya Kanti Mandal	PG
32	Sayan Das	PG
33	Sumana Maity	PG
34	Bidisha Sasmal	UG

Registration

S.N.	Student Name	UG/PG
1	Somsankar Mandal	UG
2	Suman Das	UG
3	Amiyendra Maiti	UG
4	Soumyadeep Bej	UG
5	Jatindranath Samanta	UG
6	Sudipta Mondal	UG
7	Ranajit Mandal	UG
8	Atanu Maity	UG
9	Bachaspati Mondal	UG
10	Shubhajit Giri	UG
11	Surajit Maity	UG
12	Ayan Pradhan	UG
13	Rajkumar Karan	UG
14	Soumitra Das	UG
15	Bidisha Sasmal	UG
16	Sonali Mandal	UG
17	Sudeshna Maity	UG
18	Annesha Khatua	UG
19	Paramita Maity	UG
20	Megha Rani Sahoo	UG
21	Gaurangi Pal	UG
22	Subhadip Mahapatra	UG
23	Amit Patra	UG

Five Days Workshop for Problem & Year Wise Questions Paper Solved:

Duration: 4^{th} January- 8^{th} January, 2022

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Day-1:

Topic :Linear Algebra, Real Analysis,

Speaker: Bikash panda, SACT, Dept of Mathematics

Day-2 :

Topic : Linear Programming, Complex Analysis, Calculus

Speaker :Santu Hati, Contractual Teacher, Dept. of Mathematics

Day-3:

Topic: Algebra, Functional Analysis, Numerical Analysis, Topology

Speaker: Hironmay Manna, SACT, Dept. of Mathematics

Day-4:

Topic: ODEs, PDEs, Linear Integral Equation, Classical Mechanics

Speaker: Dr. Kalipada Maity, Associate Professor & HOD Dept. of Mathematics

Day-5:

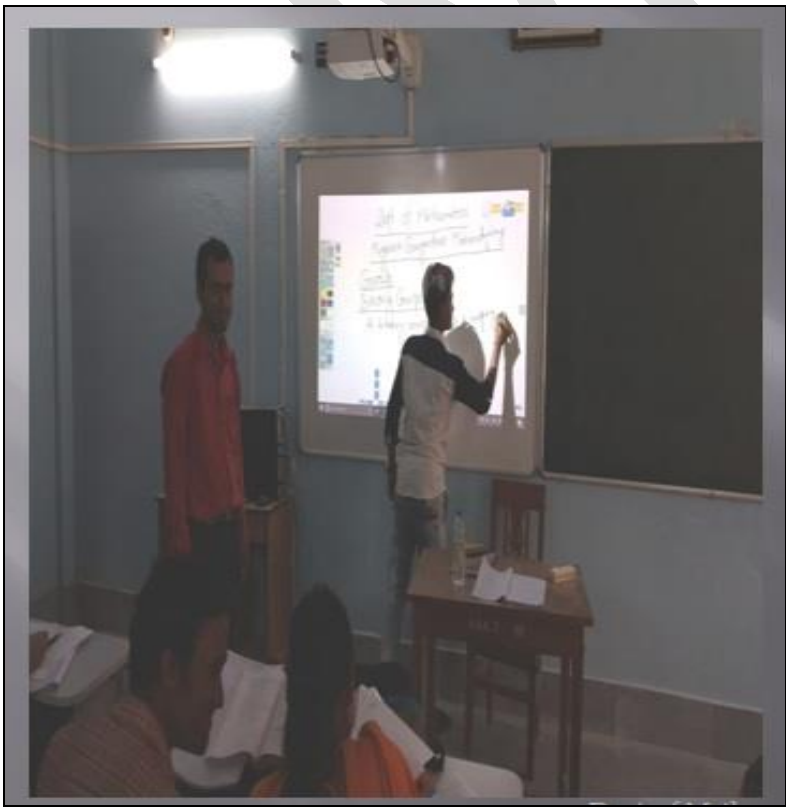
Topic: Vector Algebra, Calculus of variation, Probability & statistics

Speaker: Dr. Manoranjon De, Assistant Professor, Dept. of Mathematics

Date: 04.01.2022

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Bikash Panda, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.



Date: 05.01.2022

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing ‘**Year wise questions paper solve**’ in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Santu Hati, Teacher, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

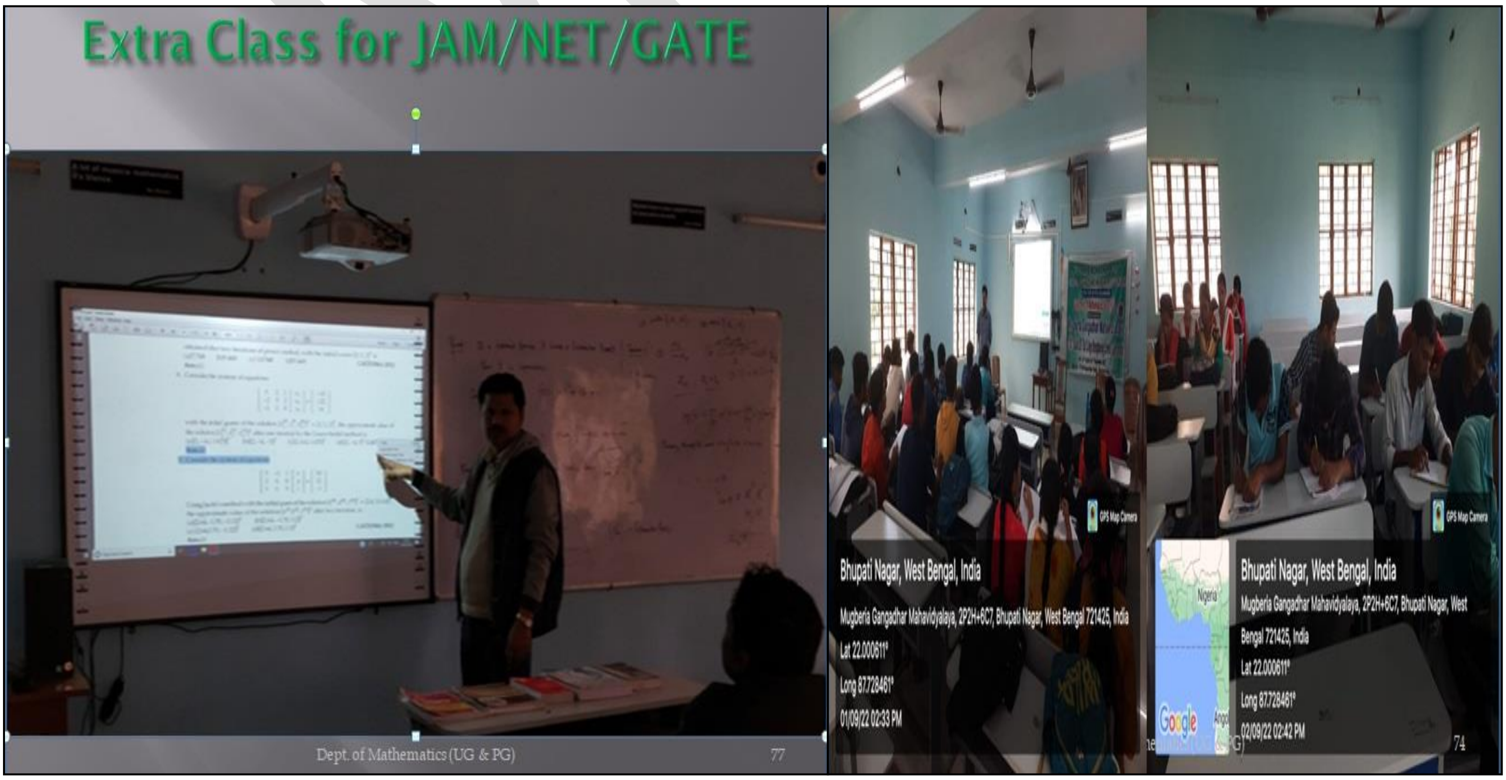
Date: 06.01.2022

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Hiranmoy Mannna, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

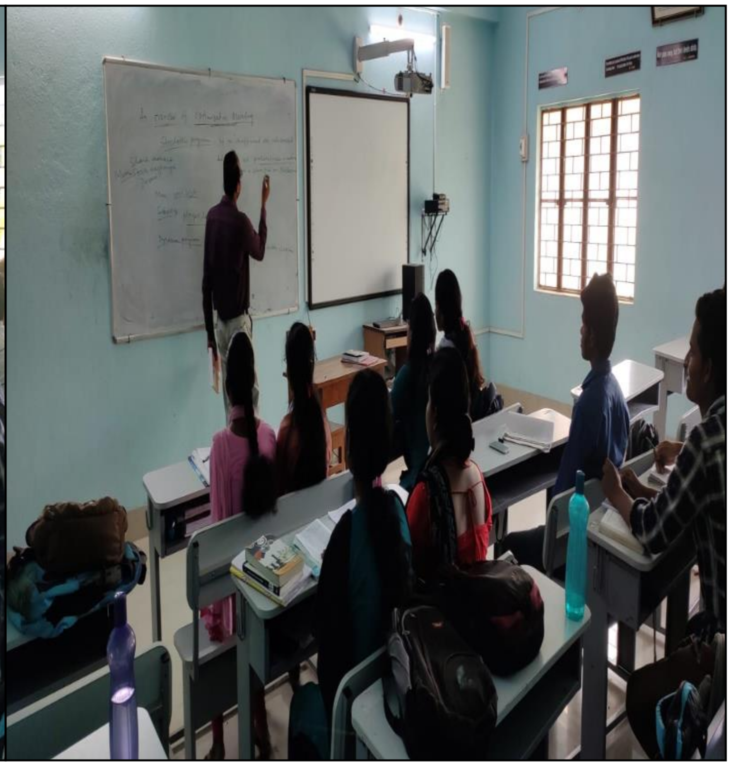
Date: 07.01.2022

Dr. Kalipada Maity, joint Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Partial Differential Equation field. All in all, the day’s program was a grand success.



Date: 08.01.2022

Dr. Manoranjan De, Assistant Professor, Mathematics Department give a ppt presentation in Vector calculus, probality and statistics field. All in all, the day’s program was a grand success.



Registration

S.N.	Student Name	UG/PG
1	MeghaSantra	UG
2	BithiMaikap	UG
3	Subhajit Jana	UG
4	Sourav Das	UG
5	Indrani Das	UG
6	Anwesha Samanta	UG
7	Nandita Jana	UG
8	SaswatiGiri	UG
9	PabitraMondal	UG
10	ParthaPratimMaity	UG
11	Manoj Maity	UG
12	Ranjit Pradhan	UG
13	Samik Das	UG
14	SantuBera	UG
15	Subhadip Jana	UG
16	BithiMaikap	UG
17	Subhajit Jana	UG
18	Sourav Das	UG
19	Indrani Das	UG
20	SantuBera	UG
21	Subhadip Jana	UG
22	SouravTripathy	UG
23	SuryadipBarik	UG

List of GATE qualifying students in the session 2021-22

1. SUKHENDU DAS ADHIKARY (PG-2019)
2. Rabindranath Bhoj (PG-2019)
3. Manish Acharyya (PG-2021)
4.

List of GATE qualifying students in the session 2020-21

1. Subhasish Das (PG-2020)
2. Rabindranath Bhoj (PG-2019)
3. Sandip Das (PG-2020)
4. Ramkrishna Bar (PG-2020)
5. Bubun Das (UG)
6. Sukhendu Das Adhikary (PG-2019)
7. SUNAYANI MONDAL (PG-2020)

List of CSIR-NET qualifying students in the session 2021-22

1. SUNAYANI MONDAL (PG-2020)
2. SUKHENDU DAS ADHIKARY(PG-2019)
3. Bubun Das (UG)
4. Rabindranath Bhoj (PG-2019)

Report
Of
Workshop on NET, GATE, NBHM & TFIR syllabus with Problem & Year Wise Questions Paper Solved

Course period: 25th August- 26nd August, 2022
4th January-8th January, 2023

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Organized
by
NSS Units of Mugberia Gangadhar Mahavidyalaya
Participated
by

Department of Mathematics (UG & PG)

(In collaboration with DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^+

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/08/2022

Minutes of the Departmental meeting held on 18.08.2019

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof.

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact. (Jt. Co-oridinator)

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. Goutam Mandal, Contractual teacher (Coordinator)

(8) Mr. SantuHati, Contractual teacher.

A short meeting was arranged at 3:15 pm regarding the Two Days Workshop on NET, GATE, NBHM& TFIR syllabus in our Department. All teachers of the department joined the meeting in time. Dr. Kalipada Maity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Goutam Mandal will be the coordinator of this program and Mr. Bikash Ponda will be program jt. Co-ordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 25 August, 2022 to 26 August 2022

(3) The participation students will be UG-5th Sem,and PG-1st & 3rd sem.

(3) Course content for the said program is scheduled as

(i) Help to choose the right career Help to provide expert resources

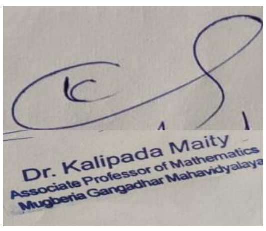
(ii)Help to gain confidence and insight Help to change unwanted behaviour pattern

(iii) Help to reduce career related frustrations

(iv)Help to provide a role model Help to bring stability in thought process

It is decided that the course will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23thAugust 2022. HoD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

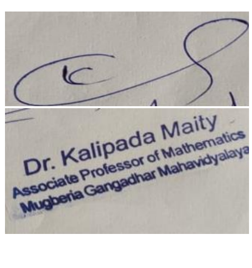


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 20/08/2022

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" from 25thAugust, 2022 to 26th August 202in our department through online mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 100. There is no course access fee for the student. Last date of registration for this program is 23rd August 2022. All the students of our college especially of our dept. are requested to be present in this course.



Two Days Workshop on NET, GATE, NBHM& TFIR syllabus

Date: 25.08.2022

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville

eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation; Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART 'B' AND 'C' MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's

theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests,

likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

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6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Date: 26.08.2022

Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

a. NBHM Syllabus in Mathematics

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

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3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations, characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Riemann integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log,

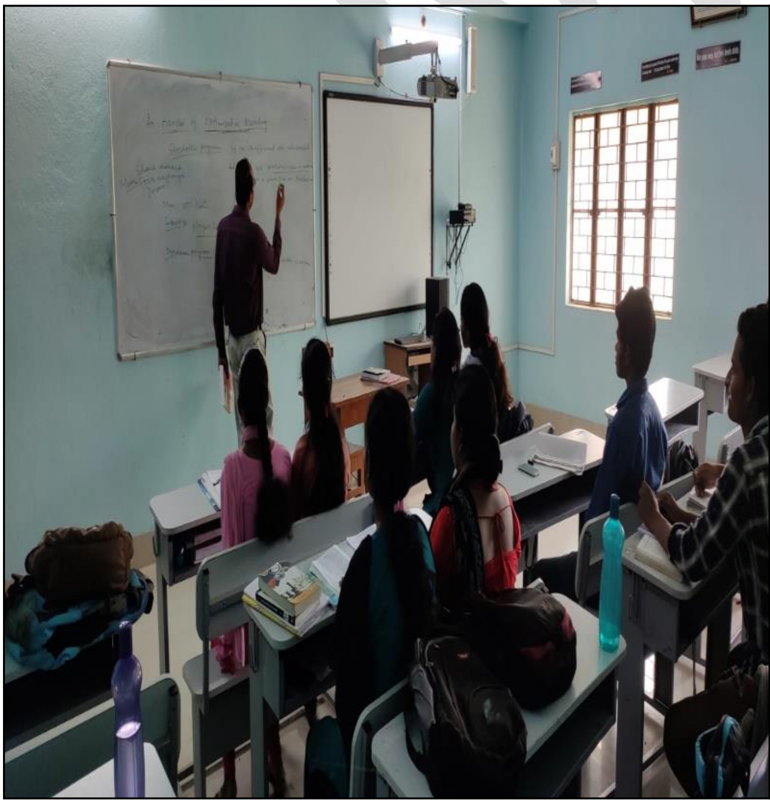
trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.

Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington



Registration

S.N.	Student Name	UG/PG
1	Amiya Mandal	PG
2	Biren Pahari	PG
3	Biswajit Mondal	PG
4	Buddhadev Jana	PG
5	Debabrata Patra	PG
6	Debajyoti Maity	PG
7	Ditangshu Barman	PG
8	Goutam Jana	PG
9	Krishendu Pradhan	PG
10	Moumita Sardar	PG
11	Poushali Tripathy	PG
12	Pradyot Dalapati	PG
13	Priti Das Adhikari	PG
14	Puspendu Sau	PG
15	Raja Kumar Shee	PG
16	Saikat Jana	PG
17	Sachayan Laha	PG
18	Shrabani Jana	PG
19	Shyamal Bera	PG
20	Snehasish Bhowmik	PG
21	Snigdha Mandal	PG
22	Shreya Jana	PG
23	Subhadip Mandal	PG
24	Subhamay Das	PG
25	Subinoy Patra	PG
26	Suchismita Pradhan	PG
27	Sudeshna Maity	PG
28	Susmita Sahoo	PG
29	Tapasi Karan	PG
30	Sahib Bera	PG
31	Soumya Kanti Mandal	PG
32	Sayan Das	PG
33	Sumana Maity	PG
34	Bidisha Sasmal	UG

Registration

S.N.	Student Name	UG/PG
1	Somsankar Mandal	UG
2	Suman Das	UG
3	Amiyendra Maiti	UG
4	Soumyadeep Bej	UG
5	Jatindranath Samanta	UG
6	Sudipta Mondal	UG
7	Ranajit Mandal	UG
8	Atanu Maity	UG
9	Bachaspati Mondal	UG
10	Shubhajit Giri	UG
11	Surajit Maity	UG
12	Ayan Pradhan	UG
13	Rajkumar Karan	UG
14	Soumitra Das	UG
15	Bidisha Sasmal	UG
16	Sonali Mandal	UG
17	Sudeshna Maity	UG
18	Annesha Khatua	UG
19	Paramita Maity	UG
20	Megha Rani Sahoo	UG
21	Gaurangi Pal	UG
22	Subhadip Mahapatra	UG
23	Amit Patra	UG

Five Days Workshop for Problem & Year Wise Questions Paper Solved:

Duration: 2th January- 6th January, 2023

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Day-1:

Topic : Linear Algebra, Real Analysis,

Speaker: Bikash panda, SACT, Dept of Mathematics

Day-2 :

Topic : Linear Programming, Complex Analysis, Calculus

Speaker :Santu Hati, Contractual Teacher, Dept. of Mathematics

Day-3:

Topic: Algebra, Functional Analysis, Numerical Analysis, Topology

Speaker: Hironmay Manna, SACT, Dept. of Mathematics

Day-4:

Topic: ODEs, PDEs, Linear Integral Equation, Classical Mechanics

Speaker: Dr. Kalipada Maity, Associate Professor & HOD Dept. of Mathematics

Day-5:

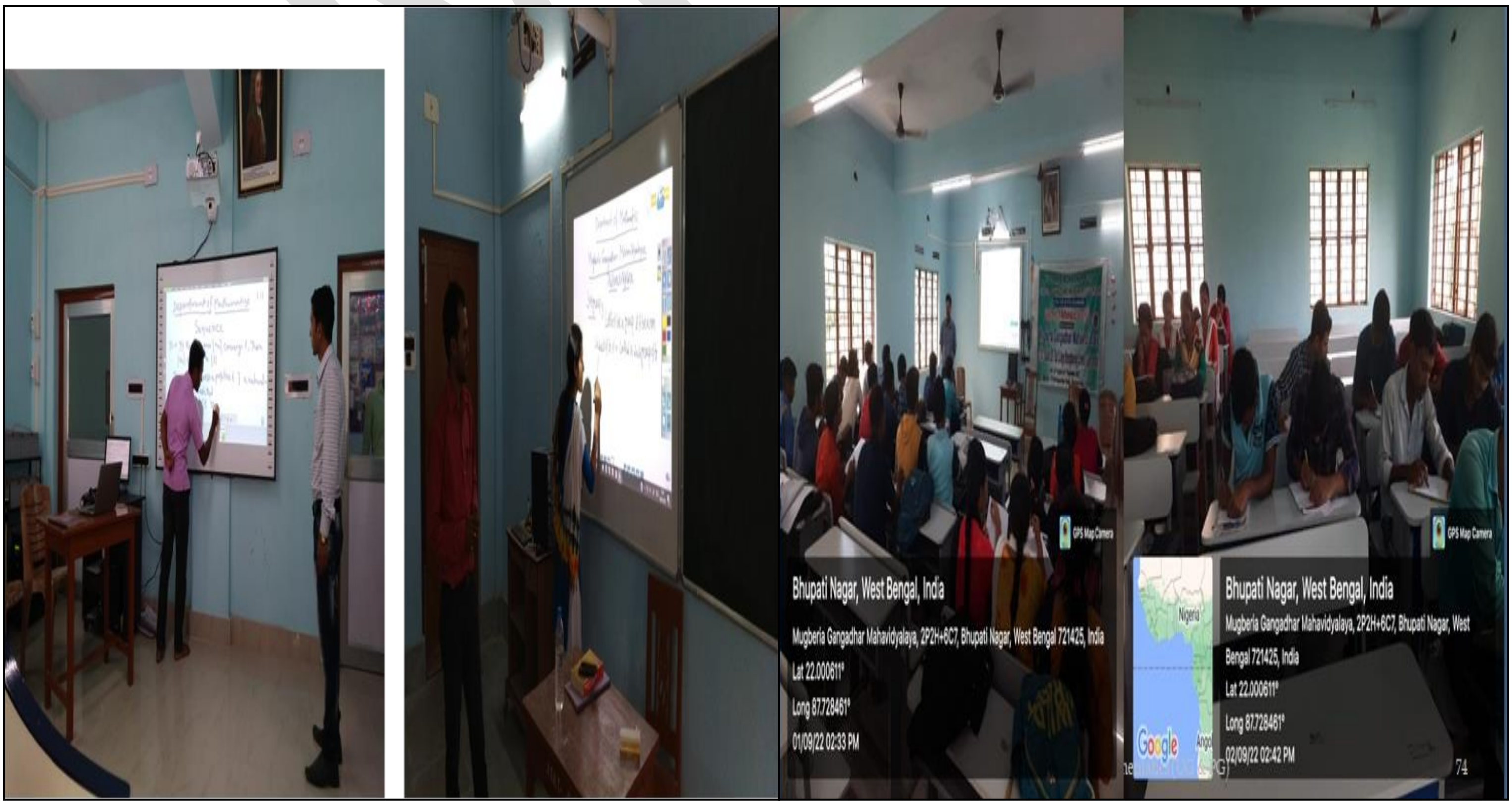
Topic: Vector Algebra, Calculus of variation, Probability & statistics

Speaker: Dr. Manoranjon De, Assistant Professor, Dept. of Mathematics

Date: 02.01.2023

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing ‘**Year wise questions paper solve**’ in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Bikash Panda, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.



Date: 03.01.2023

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Santu Hati, Teacher, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

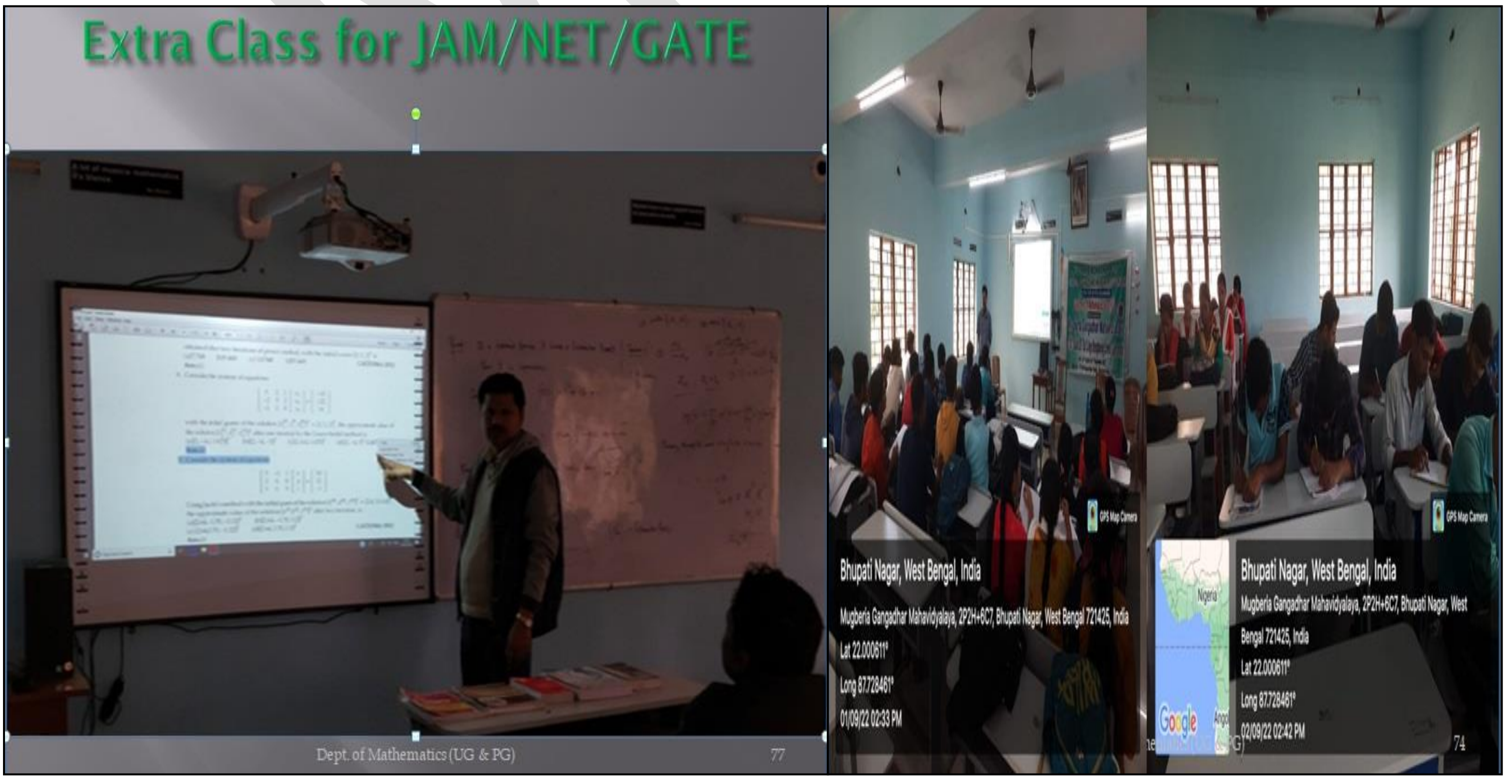
Date: 04.01.2023

In the welcome address Dr. Kalipada Maity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing '**Year wise questions paper solve**' in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation.

Mr. Hiranmoy Mannna, SACT, Department of Mathematics discussed about the job opportunities of the present course and allied scopes of the same. He advised participants to utilize their time in routine as well as rigorous practices of job-related study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded.

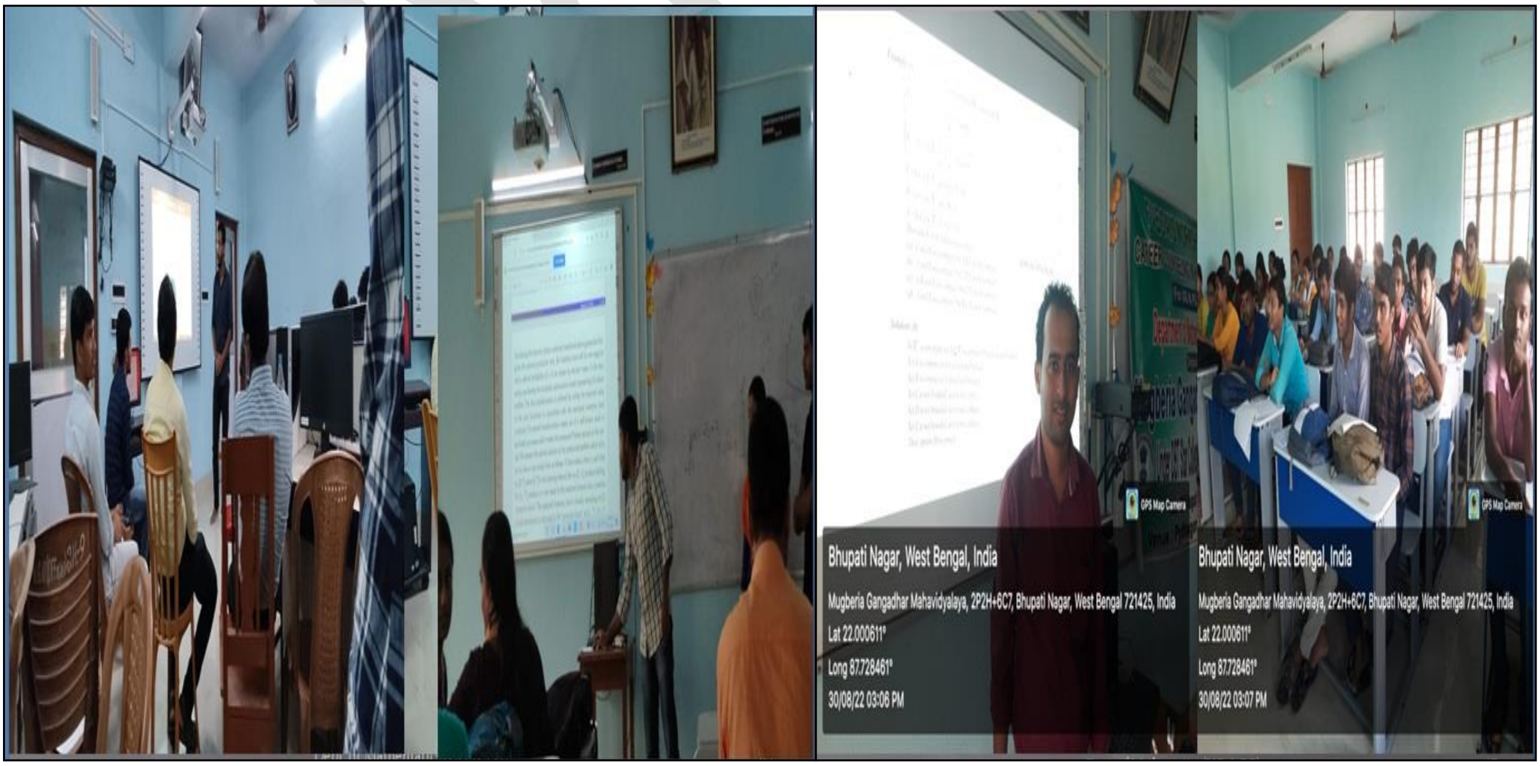
Date: 05.01.2023

Dr. Kalipada Maity, joint Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Partial Differential Equation field. All in all, the day’s program was a grand success.



Date: 06.01.2023

Dr. Manoranjan De, Assistant Professor, Mathematics Department give a ppt presentation in Vector calculus, probality and statistics field. All in all, the day's program was a grand success.



Registration

S.N.	Student Name	UG/PG
1	MeghaSantra	UG
2	BithiMaikap	UG
3	Subhajit Jana	UG
4	Sourav Das	UG
5	Indrani Das	UG
6	Anwesha Samanta	UG
7	Nandita Jana	UG
8	SaswatiGiri	UG
9	PabitraMondal	UG
10	ParthaPratimMaity	UG
11	Manoj Maity	UG
12	Ranjit Pradhan	UG
13	Samik Das	UG
14	SantuBera	UG
15	Subhadip Jana	UG
16	BithiMaikap	UG
17	Subhajit Jana	UG
18	Sourav Das	UG
19	Indrani Das	UG
20	SantuBera	UG
21	Subhadip Jana	UG
22	SouravTripathy	UG
23	SuryadipBarik	UG

List of GATE qualifying students in the session 2021-22

1. SUKHENDU DAS ADHIKARY (PG-2019)
2. Rabindranath Bhoj (PG-2019)
3. Manish Acharyya (PG-2021)
4.

List of GATE qualifying students in the session 2020-21

1. Subhasish Das (PG-2020)
2. Rabindranath Bhoj (PG-2019)
3. Sandip Das (PG-2020)
4. Ramkrishna Bar (PG-2020)
5. Bubun Das (UG)
6. Sukhendu Das Adhikary (PG-2019)
7. SUNAYANI MONDAL (PG-2020)

List of CSIR-NET qualifying students in the session 2021-22

1. SUNAYANI MONDAL (PG-2020)
2. SUKHENDU DAS ADHIKARY(PG-2019)
3. Bubun Das (UG)
4. Rabindranath Bhoj (PG-2019)

Report
Of
Five Days Workshop for Joint Admission Test for Masters (JAM)

Course period: 12^{th} - 16^{th} November, 2018

Organized
by

Department of Mathematics(UG & PG)

(Under DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^{+}

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 2/11/2018

Minutes of the Departmental meeting held on 2.11.2018

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof. (Coordinator)

(2) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact.

(6) Mr. Hiranmoy Manna, Sact.

A short meeting was arranged at 3:15 pm regarding the workshop for joint admission test for masters (JAM) in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided Dr.KalipadaMaity (HOD) will be program coordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 12 November, 2018 to 16 November, 2018

(3) The participation students will be UG-5th Sem,and UG-3rd sem.

(3) **Course Syllabus**

Real Analysis:

Sequences and Series of Real Numbers: convergence of sequences, bounded and monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, absolute convergence, tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), radius and interval of convergence, term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, maxima and minima, Riemann integration (definite integrals and their properties), fundamental theorem of calculus.

Multivariable Calculus and Differential Equations:

Functions of Two or Three Real Variables: limit, continuity, partial derivatives, total derivative, maxima and minima.

Integral Calculus: double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

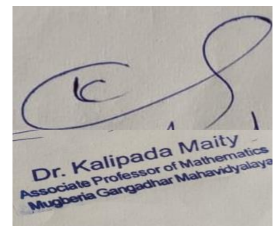
Differential Equations: Bernoulli's equation, exact differential equations, integrating factors, orthogonal trajectories, homogeneous differential equations, method of separation of variables, linear differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Linear Algebra and Algebra:

Matrices: systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.
Groups: cyclic groups, abelian groups, non-abelian groups, permutation groups, normal subgroups, quotient groups, Lagrange's theorem for finite groups, group homomorphisms.

It is decided that the course will be delivered by lecture, interaction and presentation by ppt. Available seat to register the program is 50. There is no course access fee for the student.Last date of registration for this program is 10th November 2018. HOD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.
The meeting comes to end with a vote of thanks.

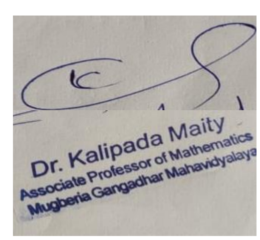


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 2/11/2018

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "**Five days workshop for joint admission test for masters (JAM)**" from 12th November, 2018 to 16th November 2018 in our department through offline mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 10th November 2018. All the students of our college especially of our dept. are requested to be present in this course.



Five Days Workshop for Joint Admission Test for Masters (JAM)

Organized by

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

Date: 12th November to 16th November 2018

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Day-1

Monday 12/11/2018

1. Dr. Swapan Kumar Misra, Principal Mugberia Gangadhar Mahavidyalaya (2.15 P.M– 2.30 P.M)
2. Dr. Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya.(2.30 P.M-3.00 P.M)
3. Mr. Bikash Panda SACT Department of Mathematics (3.00-4.00P.M)

Day-2

Tuesday 13/11/2018

1. Dr. Bidhan Chandra Samanta, DBT Coordinator & Associate Prof. & HOD, Department of Chemistry (2.15 P.M- 2.30 P.M).
2. Mr. Suman Giri, SACT, Department of Mathematics. (2.30 P.M- 4.30 P.M)

Day-3

Wednesday 14/11/2018

1. Dr Prasenjit Ghosh, IQAC Coordinator & Associate Prof. & HOD, Department of History (2.15 P.M- 2.30 P.M)
2. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya (2.30 P.M – 3.30 P.M)
3. Mr.Debraj Manna, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-4

Thursday 15/11/2018

1. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, (2.15 P.M – 2.30 P.M)
2. Mr. Hironmoy Manna SACT, Department of Mathematics (2.30 P.M- 3.30 P.M)

Examination (2.15 p.m- 4.15 p.m)

Friday 16/11/2018

Registration

Sl.No.	Students Name	UG
1	Goutam Jana	I Sem
2	Puspendu Sau	I Sem
3	Rathin Samanta	I Sem
4	Subinoy Patra	I Sem
5	Mrinmay mahapatra	I Sem
6	Saheb Bera	I Sem
7	Srikrishna Maity	I Sem
8	Surajit Kar	I Sem
9	Subhadip Sahoo	I Sem
10	Kallol Jana	I Sem
11	Subha Bhunia	I Sem
12	Prasenjit Mandal	I Sem
13	Shyamal Bera	I Sem
14	Tanmoy Bera	I Sem
15	Buddhadev Jana	I Sem
16	Rathindranath Sahu	I Sem
17	Arnab Maity	I Sem
18	Sumana Mandal	I Sem
19	Shrabani Jana	I Sem
20	Sreya Jana	I Sem
21	Priti Das Adhikari	I Sem
22	Poushali Tripathy	I Sem
23	Tapasi Karan	I Sem
24	Suchismita Pradhan	I Sem
25	Susmita Sahoo	I Sem
26	Arijit Maity	III Sem
27	Surya Kanta Kandar	III Sem
28	Biswaranjan Manna	III Sem
29	Basudev Maity	III Sem
30	Subha Ghorai	III Sem
31	Sabyasachi Mandal	III Sem
32	Sourav Bera	III Sem
33	Subhendu Bhunia	III Sem
34	Udita Sahoo	III Sem
35	Piu Maity	III Sem
36	Anuradha Sau	III Sem
37	Moumita Maity	III Sem
38	Bhagyashree Jana	III Sem
39	Sayani Roy	III Sem

40	Priti Chanda	III Sem
41	Sangita Das	III Sem
42	Anasua Maity	III Sem
43	Soumendu Nanda	III Sem
44	Anupama Ojha	III Sem
45	Susmita Pal	III Sem
46	Pritam Nayak	III Sem
47	Uttam Sen	III Sem
48	Srikrishna Das	III Sem

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Date-12th -16th November, 2018

In the light of this, a committee was formed under the mentorship of the Principal, Mugberia Gangadhar Mahavidyalaya, Dr. Swapan Kumar Mishra and Dr. KalipadaMaity, Asso. Prof.and hod of Department of Mathematics as Convener to conduct the program in a systematic manner. The five days "**Joint admission test for masters (JAM)**" was completed successfully under the proper guidance of Hon'ble Principal Sir Dr Swapan Kumar Mishra and Hon'ble Dr. Kalipada Maity sir (Associate Professor, HOD, NAAC Coordinator), through face-to-face program as held from, 12th -16th November, 2018 with 45 participants.

In the welcome address Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing **'Joint admission test for masters (JAM)'**. Learners should do self-analysis to find out their strengths as well as weaknesses. After complete graduation degree students have opportunity to take admission in IIT/ NIT for M.Sc in Mathematics by passing JAM examination.

Dr. Bidhan Chandra Samanta, Associate Professor, DBT Coordinator, HOD of Chemistry Department, the first speaker of the technical session of the program had discussed about the scopes and opportunities of higher studies. He ended his speech with lots of blessings and good wishes for the participants in their future life.

Dr. Prasenjit Ghosh, Associate Professor, IQAC Coordinator, Department of History discussed about the job opportunities of the present course and allied scopes of the same. He also advised participants to utilize their time in routine as well as rigorous practices of JAM study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded. And he said keep the target always high then you will get success one day.

Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Differential Equation field. All in all, the day’s program was a grand success.

Mr Suman Kumar Giri, Sact, Mathematics Department give a ppt presentation in Linear algebra area. All in all, the day’s program was a grand success.

Mr Debraj Manna, Sact, Mathematics Department give a ppt presentation in Abstract algebra area. All in all, the day’s program was a grand success.

Mr Bikash Panda, Sact, Mathematics Department give a ppt presentation in Real Analysis area. All in all, the day’s program was a grand success.

Mr Hironmoyee Manna, Sact, Mathematics Department give a ppt presentation in Integral Calculus area. All in all, the day’s program was a grand success.

Last day of the speech of the last speaker, there was an interactive session with the participants conducted by Mr. Bikash Panda, Joint Coordinator, Contractual Teacher, Lots of relevant questions were raised by the participants like further opportunities after completion M.Sc and the linked courses for further study etc. All pertinent queries of the participants were resolved by the resource persons with their insights and erudite reply. Last day Mr. Bikash Panda take a examination on the JAM related syllabus. At the end of the program the vote of thanks was proposed by Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Department of Mathematics.

Dr. Kalipada Maity — Coordinator & HOD

Dr. Swapan Kumar Mishra — Principal

Report
Of
Five Days Workshop for Joint Admission Test for Masters (JAM)

Course period: 11th -15th November, 2019

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Organized
by

Department of Mathematics(UG & PG)
(Under DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^+

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/10/2019

Minutes of the Departmental meeting held on 18.10.2019

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof. (Coordinator)

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact.

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. SantuHati, Contractual teacher. (Joint Coordinator)

(8) Mr. Goutam Mandal, Contractual teacher

A short meeting was arranged at 3:15 pm regarding the workshop for joint admission test for masters (JAM) in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Santu Hati will be the joint coordinator of this program and Dr.KalipadaMaity (HOD) will be program coordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 11 November, 2019 to 15 November, 2019

(3) The participation students will be UG-5th Sem,and UG-3rd sem.

(3) **Course Syllabus**

Real Analysis:

Sequences and Series of Real Numbers: convergence of sequences, bounded and monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, absolute convergence, tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), radius and interval of convergence, term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, maxima and minima, Riemann integration (definite integrals and their properties), fundamental theorem of calculus.

Multivariable Calculus and Differential Equations:

Functions of Two or Three Real Variables: limit, continuity, partial derivatives, total derivative, maxima and minima.

Integral Calculus: double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Differential Equations: Bernoulli's equation, exact differential equations, integrating factors, orthogonal trajectories, homogeneous differential equations, method of separation of variables, linear

differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Linear Algebra and Algebra:

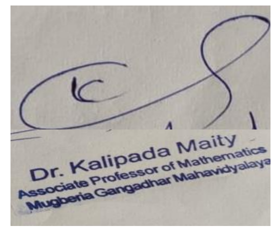
Matrices: systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.

Groups: cyclic groups, abelian groups, non-abelian groups, permutation groups, normal subgroups, quotient groups, Lagrange's theorem for finite groups, group homomorphisms.

It is decided that the course will be delivered by lecture, interaction and presentation by ppt. Available seat to register the program is 50. There is no course access fee for the student.Last date of registration for this program is 7thSeptember 2022. HOD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

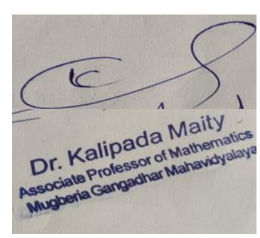


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 21/10/2019

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "**Five days workshop for joint admission test for masters (JAM)**" from 11th November, 2019 to 15th November 2019 in our department through offline mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 07th November 2019. All the students of our college especially of our dept. are requested to be present in this course.



Five Days Workshop for Joint Admission Test for Masters (JAM)

Organized by

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

Date: 11th November to 15th November 2019

Pythagoras Hall, Room No: 237

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Day-1

Monday 11/11/2019

1. Dr. Swapan Kumar Misra, Principal Mugberia Gangadhar Mahavidyalaya (2.15 P.M– 2.30 P.M)
2. Dr. Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya.(2.30 P.M-3.00 P.M)
3. Mr. Bikash Panda SACT Department of Mathematics (3.00-4.00P.M)

Day-2

Tuesday 12/11/2019

1. Dr. Bidhan Chandra Samanta, DBT Coordinator & Associate Prof. & HOD, Department of Chemistry (2.15 P.M- 2.30 P.M).
2. Dr Manoranjan De, Assistant Professor, Department of Mathematics (2.30 P.M- 3.30 P.M)
3. Mr. Suman Giri, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-3

Wednesday 13/11/2019

1. Dr Prasenjit Ghosh, IQAC Coordinator & Associate Prof. & HOD, Department of History (2.15 P.M- 2.30 P.M)
2. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya (2.30 P.M – 3.30 P.M)
3. Mr.Debraj Manna, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-4

Thursday 14/11/2019

1. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, (2.15 P.M – 2.30 P.M)
2. Mr. Goutam kumar Mondal, Contractual Teacher , Department of Mathematics (2.30 P.M – 3.30 P.M)
3. Mr. Hironmoy Manna SACT, Department of Mathematics (3.30 P.M- 4.30 P.M)

Examination (2.15 p.m- 4.15 p.m) Santu Hati Contractual Teacher

Friday 15/11/2019

Registration

Sl.No.	Students Name	UG
1	Goutam Jana	III Sem
2	Puspendu Sau	III Sem
3	Rathin Samanta	III Sem
4	Subinoy Patra	III Sem
5	Mrinmay mahapatra	III Sem
6	Saheb Bera	III Sem
7	Srikrishna Maity	III Sem
8	Surajit Kar	III Sem
9	Subhadip Sahoo	III Sem
10	Kallol Jana	III Sem
11	Subha Bhunia	III Sem
12	Prasenjit Mandal	III Sem
13	Shyamal Bera	III Sem
14	Tanmoy Bera	III Sem
15	Buddhadev Jana	III Sem
16	Rathindranath Sahu	III Sem
17	Arnab Maity	III Sem
18	Sumana Mandal	III Sem
19	Shrabani Jana	III Sem
20	Sreya Jana	III Sem
21	Priti Das Adhikari	III Sem
22	Poushali Tripathy	III Sem
23	Tapasi Karan	III Sem
24	Suchismita Pradhan	III Sem
25	Susmita Sahoo	III Sem
26	Arijit Maity	V Sem
27	Surya Kanta Kandar	V Sem
28	Biswaranjan Manna	V Sem
29	Basudev Maity	V Sem
30	Subha Ghorai	V Sem
31	Sabyasachi Mandal	V Sem
32	Sourav Bera	V Sem
33	Subhendu Bhunia	V Sem
34	Udita Sahoo	V Sem
35	Piu Maity	V Sem
36	Anuradha Sau	V Sem
37	Moumita Maity	V Sem
38	Bhagyashree Jana	V Sem
39	Sayani Roy	V Sem

40	Priti Chanda	V Sem
41	Sangita Das	V Sem
42	Anasua Maity	V Sem
43	Soumendu Nanda	V Sem
44	Anupama Ojha	V Sem
45	Susmita Pal	V Sem
46	Pritam Nayak	V Sem
47	Uttam Sen	V Sem
48	Srikrishna Das	V Sem

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Date-11th -15th November, 2019

In the light of this, a committee was formed under the mentorship of the Principal, Mugberia Gangadhar Mahavidyalaya, Dr. Swapan Kumar Mishra and Dr. KalipadaMaity, Asso. Prof.and hod of Department of Mathematics as Convener to conduct the program in a systematic manner. The five days "**Joint admission test for masters (JAM)**" was completed successfully under the proper guidance of Hon'ble Principal Sir Dr Swapan Kumar Mishra and Hon'ble Dr. Kalipada Maity sir (Associate Professor, HOD, NAAC Coordinator), through face-to-face program as held from, 11th -15th November, 2019 with 45 participants.

In the welcome address Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing **'Joint admission test for masters (JAM)'**. Learners should do self-analysis to find out their strengths as well as weaknesses. After complete graduation degree students have opportunity to take admission in IIT/ NIT for M.Sc in Mathematics by passing JAM examination.

Dr. Bidhan Chandra Samanta, Associate Professor, DBT Coordinator, HOD of Chemistry Department, the first speaker of the technical session of the program had discussed about the scopes and opportunities of higher studies. He ended his speech with lots of blessings and good wishes for the participants in their future life.

In the welcome address Dr. Manoranjan De, Assistant Professor, Dept of Mathematics discussed in details about different opportunities after completion of the present course along with multiple options to switch over from the present domain of discipline to some other. Most of the participants of camp were the Mathematics Learners, hence, Dr. Manoranjan De explained briefly about the necessity of earning 'Continuing Rehabilitation Education (CRE)' points for teacher trainees in different field of Mathematics for the persons with disabilities.

Dr. Prasenjit Ghosh, Associate Professor, IQAC Coordinator, Department of History discussed about the job opportunities of the present course and allied scopes of the same. He also advised participants to utilize their time in routine as well as rigorous practices of JAM study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded. And he said keep the target always high then you will get success one day.

Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Differential Equation field. All in all, the day's program was a grand success.

Dr., Manoranjan De, Assistant Professor, Dept of Mathematics give a ppt presentation in Function of real variables field. All in all, the day's program was a grand success

Mr Suman Kumar Giri, Sact, Mathematics Department give a ppt presentation in Linear algebra area. All in all, the day's program was a grand success.

Mr Debraj Manna, Sact, Mathematics Department give a ppt presentation in Abstract algebra area. All in all, the day's program was a grand success.

Mr Bikash Panda, Sact, Mathematics Department give a ppt presentation in Real Analysis area. All in all, the day's program was a grand success.

Mr Hironmoyee Manna, Sact, Mathematics Department give a ppt presentation in Integral Calculus area. All in all, the day's program was a grand success.

Mr Goutam Kumar Mondal, Contractual Teacher, Mathematics Department give a ppt presentation in Real Analysis area. All in all, the day's program was a grand success.

Last day of the speech of the last speaker, there was an interactive session with the participants conducted by Mr. Santu Hati, Joint Coordinator, Contractual Teacher, Lots of relevant questions were raised by the participants like further opportunities after completion M.Sc and the linked courses for further study etc. All pertinent queries of the participants were resolved by the resource persons with their insights and erudite reply. Last day Mr. Santu Hati take a examination on the JAM related syllabus. At the end of the program the vote of thanks was proposed by Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Department of Mathematics.

Santu Hati	Dr. Kalipada Maity	Dr. Swapan Kumar Mishra
Jt. Coordinator	Coordinator & HOD	Principal

Report
Of
Five Days Workshop for Joint Admission Test for Masters (JAM)(Online)

Course period: 09th -13th November, 2020

Organized

by

Department of Mathematics(UG & PG)

(Under DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^+

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/10/2020

Minutes of the Departmental meeting held on 18.10.2020 through online.

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof. (Coordinator)

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact.

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. SantuHati, Contractual teacher. (Joint Coordinator)

(8) Mr. Goutam Mandal, Contractual teacher

A short meeting was arranged at 3:15 pm regarding the workshop for joint admission test for masters (JAM) in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Santu Hati will be the joint coordinator of this program and Dr.KalipadaMaity (HOD) will be program coordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 09 November 2020 to 13 November, 2020

(3) The participation students will be UG-5th Sem, and UG-3rd sem.

(3) **Course Syllabus**

Real Analysis:

Sequences and Series of Real Numbers: convergence of sequences, bounded and monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, absolute convergence, tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), radius and interval of convergence, term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, maxima and minima, Riemann integration (definite integrals and their properties), fundamental theorem of calculus.

Multivariable Calculus and Differential Equations:

Functions of Two or Three Real Variables: Limit, continuity, partial derivatives, total derivative, maxima and minima.

Integral Calculus: double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Differential Equations: Bernoulli's equation, exact differential equations, integrating factors, orthogonal trajectories, homogeneous differential equations, method of separation of variables, linear

differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Linear Algebra and Algebra:

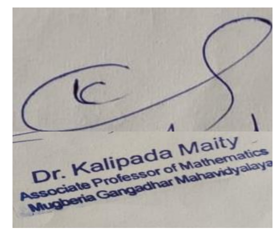
Matrices: systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.

Groups: cyclic groups, abelian groups, non-abelian groups, permutation groups, normal subgroups, quotient groups, Lagrange's theorem for finite groups, group homomorphisms.

It is decided that the course will be delivered by lecture, interaction and presentation by ppt. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 7th November 2020. HOD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

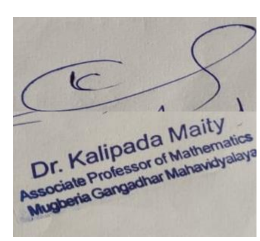


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 21/08/2020

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "**Five days workshop for joint admission test for masters (JAM)**" from 09th November, 2020 to 13th November 2020 in our department through online mode. The program will be delivered by lecture, and ppt presentation through online. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 07th November 2020. All the students of our college especially of our dept. are requested to be present in this course through online.



Five Days Workshop for Joint Admission Test for Masters (JAM)

Organized by

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

Date: 9th November to 13th November 2020

(Online Mode)

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Day-1

Monday 09/11/2020

1. Dr. Swapan Kumar Misra, Principal Mugberia Gangadhar Mahavidyalaya (2.15 P.M– 2.30 P.M)
2. Dr. Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya.(2.30 P.M-3.00 P.M)
3. Mr. Bikash Panda SACT Department of Mathematics (3.00-4.00P.M)

Day-2

Tuesday 10/11/2020

1. Dr. Bidhan Chandra Samanta, DBT Coordinator & Associate Prof. & HOD, Department of Chemistry (2.15 P.M- 2.30 P.M).
2. Dr Manoranjan De, Assistant Professor, Department of Mathematics (2.30 P.M- 3.30 P.M)
3. Mr. Suman Giri, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-3

Wednesday 11/11/2020

1. Dr Prasenjit Ghosh, IQAC Coordinator & Associate Prof. & HOD, Department of History (2.15 P.M- 2.30 P.M)
2. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya (2.30 P.M – 3.30 P.M)
3. Mr.Debraj Manna, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-4

Thursday 12/11/2020

1. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, (2.15 P.M – 2.30 P.M)
2. Mr. Goutam kumar Mondal, Contractual Teacher , Department of Mathematics (2.30 P.M – 3.30 P.M)
3. Mr. Hironmoy Manna SACT, Department of Mathematics (3.30 P.M- 4.30 P.M)

Examination (2.15 p.m- 4.15 p.m) Santu Hati Contractual Teacher

(Online)

Friday 13/11/2020

Registration

Sl.No.	Students Name	UG
1	Annesha Khatua	I Sem
2	Atanu Maity	I Sem
3	Ayan Pradhan	I Sem
4	Amiyendra Maiti	I Sem
5	Amit Patra	I Sem
6	Bachaspati Mondal	I Sem
7	Bidisha Sasmal	I Sem
8	Gourangi pal	I Sem
9	Jatindranath Samanta	I Sem
10	Megha Rani Sahoo	I Sem
11	Paramita Maity	I Sem
12	Rajkumar Karan	I Sem
13	Ranajit Mandal	I Sem
14	Subhajit Giri	I Sem
15	Sonali Mandal	I Sem
16	Soumitra Das	I Sem
17	Soumyadeep Bej	I Sem
18	Subhadip Mahapatra	I Sem
19	Surajit Maity	I Sem
20	Sudeshna Maity	I Sem
21	Sudipta Mondal	I Sem
22	Suman Das	I Sem

Registration

Sl.No.	Students Name	UG
23	Megha Santra	III Sem
24	Subhajit Jana	III Sem
25	Saswati Giri	III Sem
26	Anwesha Samanta	III Sem
27	Bithi Maikap	III Sem
28	Sourav Das	III Sem
29	Pabitra Mondal	III Sem
30	Nandita Jana	III Sem
31	Ranjit Pradhan	III Sem
32	Indrani Das	III Sem
33	Sabyasachi Maji	III Sem
34	Puspendu Maity	III Sem
35	Partha Pratim Maity	III Sem
36	Sourav Tripathi	III Sem
37	Subhadip Jana	III Sem
38	Dipak Paria	III Sem
39	Santu Bera	III Sem
40	Srijan Das	III Sem
41	Suryadip Barik	III Sem
42	Pradip Maity	III Sem
43	Monoj Maity	III Sem
44	Samik Das	III Sem
45	Debraj Mandal	III Sem

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Date-09th -13th November, 2020

The entire world is going through the grim situation owing to the COVID-19 pandemic and its new variant 'Delta' as well as 'Omicron'. In the present situation people are passing days with lots of uncertainties like threat to be infected, economic recession owing to the long period of lock down, irregularities and disruption of children's education, domestic intolerance due to no or irregular earning and old parent's physical instability as well as employment uncertainties of the educated youth. Not only these, the modern highly complicated way of life has led people in front of perpetual competition and new challenges.

In the light of this, a committee was formed under the mentorship of the Principal, Mugberia Gangadhar Mahavidyalaya, Dr. Swapan Kumar Mishra and Dr. KalipadaMaity, Asso. Prof.and hod of Department of Mathematics as Convener to conduct the program in a systematic manner. The five days "**Joint admission test for masters (JAM)**" was completed successfully under the proper guidance of Hon'ble Principal Sir Dr Swapan Kumar Mishra and Hon'ble Dr. Kalipada Maity sir (Associate Professor, HOD, NAAC Coordinator), through face-to-face program as held from, 09th -13th November, 2020 with 45 participants.

In the welcome address Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing **'Joint admission test for masters (JAM)'** in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation. Learners should do self-analysis to find out their strengths as well as weaknesses. After complete graduation degree students have opportunity to take admission in IIT/ NIT for M.Sc in Mathematics by passing JAM examination.

Dr. Bidhan Chandra Samanta, Associate Professor, DBT Coordinator, HOD of Chemistry Department, the first speaker of the technical session of the program had discussed about the scopes and opportunities of higher studies. He ended his speech with lots of blessings and good wishes for the participants in their future life.

In the welcome address Dr. Manoranjan De, Assistant Professor, Dept of Mathematics discussed in details about different opportunities after completion of the present course along with multiple options to switch over from the present domain of discipline to some other. Most of the participants of camp were the Mathematics Learners, hence, Dr. Manoranjan De explained briefly about the necessity of earning 'Continuing Rehabilitation Education (CRE)' points for teacher trainees in different field of Mathematics for the persons with disabilities.

Dr. Prasenjit Ghosh, Associate Professor, IQAC Coordinator, Department of History discussed about the job opportunities of the present course and allied scopes of the same. He also advised

participants to utilize their time in routine as well as rigorous practices of JAM study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded. And he said keep the target always high then you will get success one day.

Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Differential Equation field through online. All in all, the day's program was a grand success.

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Mr Hironmoyee Manna, Sact, Mathematics Department give a ppt presentation in Integral Calculus area through online. All in all, the day's program was a grand success.

Mr Goutam Kumar Mondal, Contractual Teacher, Mathematics Department give a ppt presentation in Real Analysis area through online. All in all, the day's program was a grand success.

Last day of the speech of the last speaker, there was an interactive session with the participants conducted by Mr. Santu Hati, Joint Coordinator, Contractual Teacher, Lots of relevant questions were raised by the participants like further opportunities after completion M.Sc and the linked courses for further study etc. All pertinent queries of the participants were resolved by the resource persons with their insights and erudite reply. Last day Mr. Santu Hati take a examination on the JAM related syllabus. At the end of the program the vote of thanks was proposed by Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Department of Mathematics.

Santu Hati	Dr. Kalipada Maity	Dr. Swapan Kumar Mishra
Jt. Coordinator	Coordinator & HOD	Principal

Report

Of

Five Days Workshop for Joint Admission Test for Masters (JAM)

Course period: 08th -12th November, 2021

Organized

by

Department of Mathematics(UG & PG)

(Under DBT STAR College strengthening Scheme (Govt. of India)

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^{+}

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/10/2021

Minutes of the Departmental meeting held on 18.10.2021

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof. (Coordinator)

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact.

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. SantuHati, Contractual teacher. (Joint Coordinator)

(8) Mr. Goutam Mandal, Contractual teacher

A short meeting was arranged at 3:15 pm regarding the workshop for joint admission test for masters (JAM) in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Santu Hati will be the joint coordinator of this program and Dr.KalipadaMaity (HOD) will be program coordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 08 November 2021 to 12 November, 2021

(3) The participation students will be UG-5th Sem,and UG-3rd sem.

(3) **Course Syllabus**

Real Analysis:

Sequences and Series of Real Numbers: convergence of sequences, bounded and monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, absolute convergence, tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), radius and interval of convergence, term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, maxima and minima, Riemann integration (definite integrals and their properties), fundamental theorem of calculus.

Multivariable Calculus and Differential Equations:

Functions of Two or Three Real Variables: limit, continuity, partial derivatives, total derivative, maxima and minima.

Integral Calculus: double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Differential Equations: Bernoulli's equation, exact differential equations, integrating factors, orthogonal trajectories, homogeneous differential equations, method of separation of variables, linear

differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Linear Algebra and Algebra:

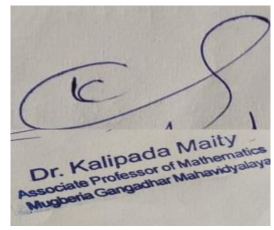
Matrices: systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.

Groups: cyclic groups, abelian groups, non-abelian groups, permutation groups, normal subgroups, quotient groups, Lagrange's theorem for finite groups, group homomorphisms.

It is decided that the course will be delivered by lecture, interaction and presentation by ppt. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 7th November 2021. HOD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.

The meeting comes to end with a vote of thanks.

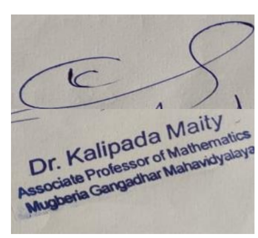


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 21/08/2021

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "**Five days workshop for joint admission test for masters (JAM)**" from 08th November, 2021 to 12th November 2021 in our department through offline mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 07th November 2021. All the students of our college especially of our dept. are requested to be present in this course.



Five Days Workshop for Joint Admission Test for Masters (JAM)

Organized by

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

Date: 8th November to 12th November 2021

Pythagoras Hall, Room No: 237

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Day-1

Monday 08/11/2021

1. Dr. Swapan Kumar Misra, Principal Mugberia Gangadhar Mahavidyalaya (2.15 P.M– 2.30 P.M)
2. Dr. Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya.(2.30 P.M-3.00 P.M)
3. Mr. Bikash Panda SACT Department of Mathematics (3.00-4.00P.M)

Day-2

Tuesday 09/11/2021

1. Dr. Bidhan Chandra Samanta, DBT Coordinator & Associate Prof. & HOD, Department of Chemistry (2.15 P.M- 2.30 P.M).
2. Dr Manoranjan De, Assistant Professor, Department of Mathematics (2.30 P.M- 3.30 P.M)
3. Mr. Suman Giri, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-3

Wednesday 10/11/2021

1. Dr Prasenjit Ghosh, IQAC Coordinator & Associate Prof. & HOD, Department of History (2.15 P.M- 2.30 P.M)
2. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya (2.30 P.M – 3.30 P.M)
3. Mr.Debraj Manna, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-4

Thursday 11/11/2021

1. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, (2.15 P.M – 2.30 P.M)
2. Mr. Goutam kumar Mondal, Contractual Teacher , Department of Mathematics (2.30 P.M – 3.30 P.M)
3. Mr. Hironmoy Manna SACT, Department of Mathematics (3.30 P.M- 4.30 P.M)

Examination (2.15 p.m- 4.15 p.m) Santu Hati Contractual Teacher

Friday 12/11/2021

Registration

Sl.No.	Students Name	UG
1	Annesha Khatua	III Sem
2	Atanu Maity	III Sem
3	Ayan Pradhan	III Sem
4	Amiyendra Maiti	III Sem
5	Amit Patra	III Sem
6	Bachaspati Mondal	III Sem
7	Bidisha Sasmal	III Sem
8	Gourangi pal	III Sem
9	Jatindranath Samanta	III Sem
10	Megha Rani Sahoo	III Sem
11	Paramita Maity	III Sem
12	Rajkumar Karan	III Sem
13	Ranajit Mandal	III Sem
14	Subhajit Giri	III Sem
15	Sonali Mandal	III Sem
16	Soumitra Das	III Sem
17	Soumyadeep Bej	III Sem
18	Subhadip Mahapatra	III Sem
19	Surajit Maity	III Sem
20	Sudeshna Maity	III Sem
21	Sudipta Mondal	III Sem
22	Suman Das	III Sem

Registration

Sl.No.	Students Name	UG
23	Megha Santra	V Sem
24	Subhajit Jana	V Sem
25	Saswati Giri	V Sem
26	Anwesha Samanta	V Sem
27	Bithi Maikap	V Sem
28	Sourav Das	V Sem
29	Pabitra Mondal	V Sem
30	Nandita Jana	V Sem
31	Ranjit Pradhan	V Sem
32	Indrani Das	V Sem
33	Sabyasachi Maji	V Sem
34	Puspendu Maity	V Sem
35	Partha Pratim Maity	V Sem
36	Sourav Tripathi	V Sem
37	Subhadip Jana	V Sem
38	Dipak Paria	V Sem
39	Santu Bera	V Sem
40	Srijan Das	V Sem
41	Suryadip Barik	V Sem
42	Pradip Maity	V Sem
43	Monoj Maity	V Sem
44	Samik Das	V Sem
45	Debraj Mandal	V Sem

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Date-08th -12th November, 2021

The entire world is going through the grim situation owing to the COVID-19 pandemic and its new variant 'Delta' as well as 'Omicron'. In the present situation people are passing days with lots of uncertainties like threat to be infected, economic recession owing to the long period of lock down, irregularities and disruption of children's education, domestic intolerance due to no or irregular earning and old parent's physical instability as well as employment uncertainties of the educated youth. Not only these, the modern highly complicated way of life has led people in front of perpetual competition and new challenges.

In the light of this, a committee was formed under the mentorship of the Principal, Mugberia Gangadhar Mahavidyalaya, Dr. Swapan Kumar Mishra and Dr. KalipadaMaity, Asso. Prof.and hod of Department of Mathematics as Convener to conduct the program in a systematic manner. The five days "**Joint admission test for masters (JAM)**" was completed successfully under the proper guidance of Hon'ble Principal Sir Dr Swapan Kumar Mishra and Hon'ble Dr. Kalipada Maity sir (Associate Professor, HOD, NAAC Coordinator), through face-to-face program as held from, 08th -12th November, 2021 with 45 participants.

In the welcome address Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, of Mathematics Department had briefly discussed about the relevance of organizing **'Joint admission test for masters (JAM)'** in the transition period to move towards the digital milieu along with the uncertainties owing to the covid situation. Learners should do self-analysis to find out their strengths as well as weaknesses. After complete graduation degree students have opportunity to take admission in IIT/ NIT for M.Sc in Mathematics by passing JAM examination.

Dr. Bidhan Chandra Samanta, Associate Professor, DBT Coordinator, HOD of Chemistry Department, the first speaker of the technical session of the program had discussed about the scopes and opportunities of higher studies. He ended his speech with lots of blessings and good wishes for the participants in their future life.

In the welcome address Dr. Manoranjan De, Assistant Professor, Dept of Mathematics discussed in details about different opportunities after completion of the present course along with multiple options to switch over from the present domain of discipline to some other. Most of the participants of camp were the Mathematics Learners, hence, Dr. Manoranjan De explained briefly about the necessity of earning 'Continuing Rehabilitation Education (CRE)' points for teacher trainees in different field of Mathematics for the persons with disabilities.

Dr. Prasenjit Ghosh, Associate Professor, IQAC Coordinator, Department of History discussed about the job opportunities of the present course and allied scopes of the same. He also advised

participants to utilize their time in routine as well as rigorous practices of JAM study with peers and making a group of the common minded peers for evaluating their performance to keep themselves upgraded. And he said keep the target always high then you will get success one day.

Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Mathematics Department give a ppt presentation in Differential Equation field. All in all, the day’s program was a grand success.

Dr., Manoranjan De, Assistant Professor, Dept of Mathematics give a ppt presentation in Function of real variables field. All in all, the day’s program was a grand success

Mr Suman Kumar Giri, Sact, Mathematics Department give a ppt presentation in Linear algebra area. All in all, the day’s program was a grand success.

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Mr Bikash Panda, Sact, Mathematics Department give a ppt presentation in Real Analysis area. All in all, the day’s program was a grand success.

Mr Hironmoyee Manna, Sact, Mathematics Department give a ppt presentation in Integral Calculus area. All in all, the day’s program was a grand success.

Mr Goutam Kumar Mondal, Contractual Teacher, Mathematics Department give a ppt presentation in Real Analysis area. All in all, the day’s program was a grand success.

Last day of the speech of the last speaker, there was an interactive session with the participants conducted by Mr. Santu Hati, Joint Coordinator, Contractual Teacher, Lots of relevant questions were raised by the participants like further opportunities after completion M.Sc and the linked courses for further study etc. All pertinent queries of the participants were resolved by the resource persons with their insights and erudite reply. Last day Mr. Santu Hati take a examination on the JAM related syllabus. At the end of the program the vote of thanks was proposed by Dr. KalipadaMaity, Coordinator, Associate Professor, HOD, NAAC Coordinator, Department of Mathematics.

Jt. Coordinator Coordinator & HOD Principal

Santu Hati Dr. Kalipada Maity Dr. Swapan Kumar Mishra

Jt. Coordinator Coordinator & HOD Principal

Report

Of

Five Days Workshop for Joint Admission Test for Masters (JAM)

Course period: 08^{th} - 13^{th} September, 2022

Organized

by

Department of Mathematics(UG & PG)

(Under DBT STAR College strengthening Scheme (Govt. of India))

Mugberia Gangadhar Mahavidyalaya

Bhupatinagar, Purba Medinipur- 721425

ACCREDITED BY NAAC WITH GRADE B^{+}

Affiliated to

Vidyasagar University

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya
NOTICE

Dated: 18/08/2022

Minutes of the Departmental meeting held on 18.08.2022

Members present:

(1) Dr. KalipadaMaity, HOD, Associate Prof. (Coordinator)

(2) Dr. Manoranjan De, Assistant Prof.

(3) Mr. Suman Giri, Sact.

(4) Mr. Debraj Manna, Sact.

(5) Mr. Bikash Panda, Sact.

(6) Mr. Hiranmoy Manna, Sact.

(7) Mr. SantuHati, Contractual teacher. (Joint Coordinator)

(8) Mr. Goutam Mandal, Contractual teacher

A short meeting was arranged at 3:15 pm regarding the workshop for joint admission test for masters (JAM) in our Department. All teachers of the department joined the meeting in time. Dr. KalipadaMaity(HOD) chaired the meeting.

Decisions taken in the meeting are:

(1) It is decided that Mr. Santu Hati will be the joint coordinator of this program and Dr.KalipadaMaity (HOD) will be program coordinator and rest teachers of the department will be the recourses persons of the program. .

(2) The course period will be scheduled from 08 September, 2022 to 13 September, 2022

(3) The participation students will be UG-5th Sem,and UG-3rd sem.

(3) **Course Syllabus**

Real Analysis:

Sequences and Series of Real Numbers: convergence of sequences, bounded and monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, absolute convergence, tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), radius and interval of convergence, term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, maxima and minima, Riemann integration (definite integrals and their properties), fundamental theorem of calculus.

Multivariable Calculus and Differential Equations:

Functions of Two or Three Real Variables: limit, continuity, partial derivatives, total derivative, maxima and minima.

Integral Calculus: double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Differential Equations: Bernoulli's equation, exact differential equations, integrating factors, orthogonal trajectories, homogeneous differential equations, method of separation of variables, linear

differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

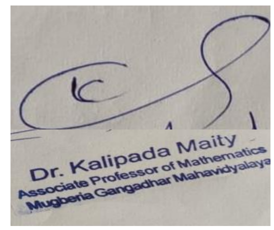
Linear Algebra and Algebra:

Matrices: systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.

Groups: cyclic groups, abelian groups, non-abelian groups, permutation groups, normal subgroups, quotient groups, Lagrange's theorem for finite groups, group homomorphisms.

It is decided that the course will be delivered by lecture, interaction and presentation by ppt. Available seat to register the program is 50. There is no course access fee for the student.Last date of registration for this program is 7thSeptember 2022. HOD will forward the matter for approval of this program from Academic Sub-committee. Teachers are requested to prepare a routine for smooth running of course.
The meeting comes to end with a vote of thanks.

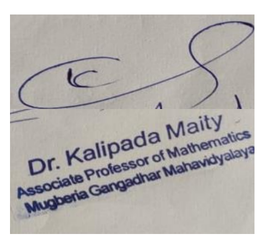


Mugberia Gangadhar Mahavidyalaya
Department of Mathematics

NOTICE

Dated: 21/08/2022

This is to hereby notify all the students that the dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a workshop on "**Five days workshop for joint admission test for masters (JAM)**" from 08th September, 2022 to 13th September 2022in our department through offline mode. The program will be delivered by lecture, interaction and ppt presentation. Available seat to register the program is 50. There is no course access fee for the student. Last date of registration for this program is 07th September 2022. All the students of our college especially of our dept. are requested to be present in this course.



Five Days Workshop for Joint Admission Test for Masters (JAM)

Organized by

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

Date: 8th September to 13th September 2022

Pythagoras Hall, Room No: 237

Under DBT STAR COLLEGE Strengthening Scheme (Govt. of India)

Day-1

Thursday 08/09/2022

1. Dr. Swapan Kumar Misra, Principal Mugberia Gangadhar Mahavidyalaya (2.15 P.M– 2.30 P.M)
2. Dr. Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya.(2.30 P.M-3.00 P.M)
3. Mr. Bikash Panda SACT Department of Mathematics (3.00-4.00P.M)

Day-2

Friday 09/09/2022

1. Dr. Bidhan Chandra Samanta, DBT Coordinator & Associate Prof. & HOD, Department of Chemistry (2.15 P.M- 2.30 P.M).
2. Dr Manoranjan De, Assistant Professor, Department of Mathematics (2.30 P.M- 3.30 P.M)
3. Mr. Suman Giri, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-3

Saturday 10/09/2022

1. Dr Prasenjit Ghosh, IQAC Coordinator & Associate Prof. & HOD, Department of History (2.15 P.M- 2.30 P.M)
2. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, Mugberia Gangadhar Mahavidyalaya (2.30 P.M – 3.30 P.M)
3. Mr.Debraj Manna, SACT, Department of Mathematics. (3.30 P.M- 4.30 P.M)

Day-4

Monday 12/09/2022

1. Dr Kalipada Maity, Associate Professor, HOD (UG & PG), Department of Mathematics, (2.15 P.M – 2.30 P.M)
2. Mr. Goutam kumar Mondal, Contractual Teacher , Department of Mathematics (2.30 P.M – 3.30 P.M)
3. Mr. Hironmoy Manna SACT, Department of Mathematics (3.30 P.M- 4.30 P.M)

Examination (2.15 p.m- 4.15 p.m) Santu Hati Contractual Teacher

Tuesday 13/09/2022

Registration

Sl.No.	Students Name	UG
1	Annesha Khatua	V Sem
2	Atanu Maity	V Sem
3	Ayan Pradhan	V Sem
4	Amiyendra Maiti	V Sem
5	Amit Patra	V Sem
6	Bachaspati Mondal	V Sem
7	Bidisha Sasmal	V Sem
8	Gourangi pal	V Sem
9	Jatindranath Samanta	V Sem
10	Megha Rani Sahoo	V Sem
11	Paramita Maity	V Sem
12	Rajkumar Karan	V Sem
13	Ranajit Mandal	V Sem
14	Subhajit Giri	V Sem
15	Sonali Mandal	V Sem
16	Soumitra Das	V Sem
17	Soumyadeep Bej	V Sem
18	Subhadip Mahapatra	V Sem
19	Surajit Maity	V Sem
20	Sudeshna Maity	V Sem
21	Sudipta Mondal	V Sem
22	Suman Das	V Sem
23	Sayan Sahoo	III Sem
24	Rudra Prakash Das	III Sem
25	Sandipan Kala	III Sem
26	Shibam Majhi	III Sem
27	Sandip Kumar Paul	III Sem
28	Debanshu Roy	III Sem
29	Pritish Bag	III Sem
30	Nandini Jana	III Sem
31	Samapti Jana	III Sem
32	Somasri Sau	III Sem
33	Ayantika Jana	III Sem
34	Basanti Mondal	III Sem
35	Sonakshi Manna	III Sem
36	Tanmoy Kumar Adak	III Sem
37	Rasbihary Mal	III Sem

Department of Mathematics
Mugberia Gangadhar Mahavidyalaya

Date-08th -13th September, 2022

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GPS Map Camera
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+395, Bhupati Nagar, West Bengal 721425, India
Lat 22.000103°
Long 87.72843°


Bhupati Nagar, West Bengal, India
Bhupati Nagar, West Bengal, India

Santu Hati	Dr. Kalipada Maity	Dr. Swapan Kumar Mishra
Jt. Coordinator	Coordinator & HOD	Principal

List of Qualifying Students in NET/GATE/SET/NBHM/CTET/TET

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	5.2.3 Number of students qualifying in state/national/ international level examinations during the year (eg: JAM/GATE/ CLAT/GMAT/CAT/GRE/ TOEFL/ Civil Services/State government examinations, etc.)															
2	Year	Registration number/roll number for the exam	Names of students selected/ qualified													
3			NET	SLET	GATE	GMAT	CAT	GRE	JAM	IELET	TOEFL	Civil Services	State government examinations	Other examinations conducted by the State / Central Government Agencies (Specify)		
4	2022-23	TET220413018												Subhendu Bhunia(TET)		
5	2022-23	TET220074917												Prathama Samanta(TET)		
6	2022-23	TET220672226												Soumen Jana(TET)		
7	2022-23	TET220328955												Anal Mishra(TET)		
8	2022-23	TET220271786												Anindita Jana(TET)		
9	2022-23	TET220412487												Nirmal Das		
10	2022-23	TET220284504												Subhasish Das(TET)		
11	2022-23	TET220158750												Durga Mandal(TET)		
12	2022-23	TET220502211												Minakshji Sarangi(TET)		
13	2022-23	TET220203973												Madhusudan Midya(TET)		
14	2022-23	TET220282108												Subha Pradhan(TET)		
15	2022-23	TET220617503												Soumendu Nanda(TET)		
16	2022-23	TET220283845												Sudip Mishra(TET)		
17	2022-23	TET220089048												Pallabita Maity(TET)		
18	2022-23	TET220396334												Sougata Bera (TET)		
19	2022-23	TET220190749												Tushar Kanti Bera(TET)		
20	2022-23	TET220109651												Pabitra Mondal(TET)		
21	2022-23	TET220131908												Bhagyashree Jana(TET)		
22	2022-23	TET220468719												Biswaranjan Manna(TET)		
23	2022-23	TET220137947												Priti Chanda(TET)		
24	2022-23	TET220318416												Sanchita Maity(TET)		
25	2022-23	TET220304696												Nandita PradhanTET)		
26	2022-23	TET220204188												Soumava Das(TET)		
27	2022-23	TET220021173												Chandan Giri(TET)		
28	2022-23	TET220290141												Puspita Jana(TET)		
29	2022-23	TET220249817												Mamata Biring(TET)		
30	2022-23	TET220484703												Moumita Sahoo(TET)		
31	2022-23	TET220024102												Amitava Patra(TET)		
32	2022-23	WB1011240136	Rabindranath Bhoj													
33	2021-22	MA22S26507537			SUKHENDU DAS ADHIKARY											
34	2021-22	MA22S26507537			Rabindranath Bhoj											
35	2021-22	1.73161E+14												Subhasish Das(CTET)		
36	2021-22	MA619A185							Sourav Das							
37	2021-22	MA615A182							Anwesha Samanta							
38	2021-22	MA614A021							Bithi Maikap							
39	2021-22	WB07000340	SUKHENDU DAS ADHIKARY													
40	2021-22	MA615A462							Megha Santra							
41	2021-22	UP18001741	SUNAYANI MONDAL													
42	2021-22	MA22S26507527			Manish Acharyya											
43	2020-21	WB10606188	SUKHENDU DAS ADHIKARY													
44	2020-21	MA21S56042274			Subhasish Das											
45	2020-21	MA21S56035032			Rabindranath Bhoj											
46	2020-21	MA21S56035152			Sandip Das											
47	2020-21	MA21S56035052			Ramkrishna Bar											
48	2020-21	MA21S56042022			Bubun Das											
49	2020-21	MA21S56036019			Sukhendu Das Adhikary											
50	2020-21	MA21S56033041			SUNAYANI MONDAL											
51	2020-21	1.73161E+14												Tushar Kanti Bera(CTET)		
52	2020-21	MA614A526							Srikrishna Das							
53	2020-21	MA613A243							Subhadip Sahoo							
54	2020-21	WB10606513	Bubun Das													
55	2018-19	210014362												Paramita Bhunia(CTET)		
56		Total	5		10				6					30	Grand Total	51
57																

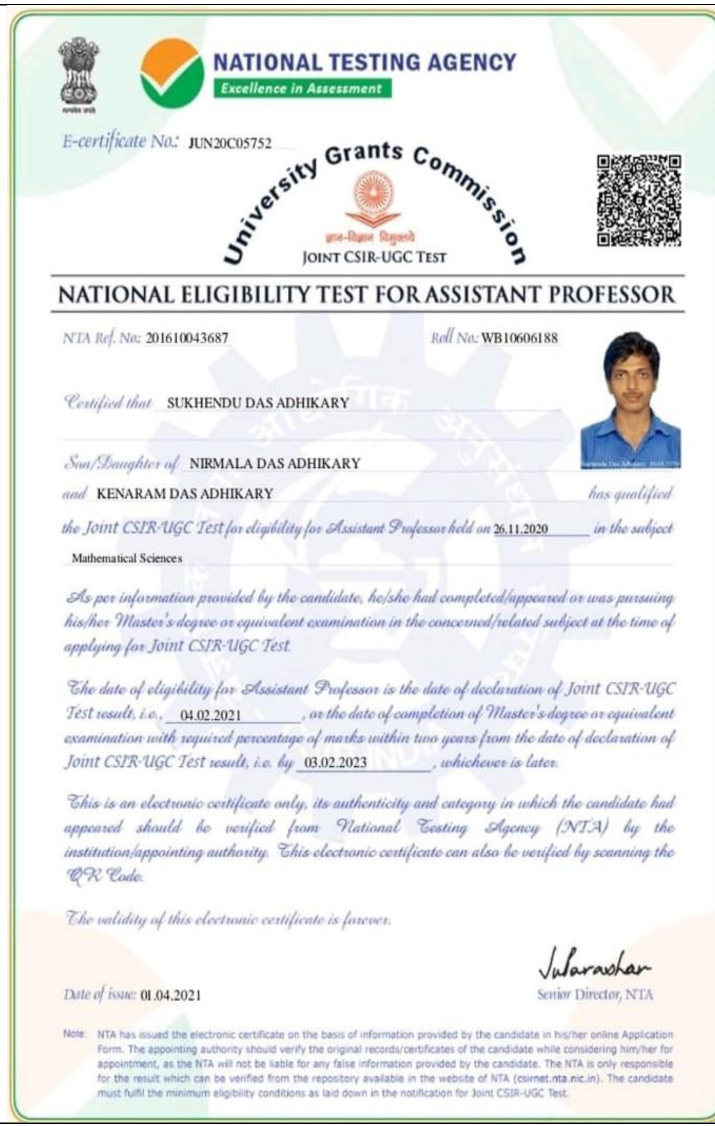
20List of students qualifying in state/national/ international level examinations during 2019 -22

(eg: JAM/GATE/ NET/SET/CTET/CLAT/GMAT/CAT/GRE/ TOEFL/ Civil Services/State government examinations, etc.)

Department of Mathematics (UG & PG)

Mugberia Gangadhar Mahavidyalaya

<table>
<tr>
<td>SUKHENDU DAS ADHIKARY
MSc (Mathematics): 2019

Roll No: WB10606188
NET -LS</td>
<td>

NATIONAL TESTING AGENCY
Excellence in Assessment

E-certificate No.: JUN20C05752

University Grants Commission
JOINT CSIR-UGC TEST

NATIONAL ELIGIBILITY TEST FOR ASSISTANT PROFESSOR

NTA Ref. No: 201610043687 Roll No: WB10606188

Certified that SUKHENDU DAS ADHIKARY

Son/Daughter of NIRMALA DAS ADHIKARY

and KENARAM DAS ADHIKARY has qualified

the Joint CSIR-UGC Test for eligibility for Assistant Professor held on 26.11.2020 in the subject

Mathematical Sciences

As per information provided by the candidate, he/she had completed/appeared or was pursuing his/her Master's degree or equivalent examination in the concerned/related subject at the time of applying for Joint CSIR-UGC Test.

The date of eligibility for Assistant Professor is the date of declaration of Joint CSIR-UGC Test result, i.e., 04.02.2021, or the date of completion of Master's degree or equivalent examination with required percentage of marks within two years from the date of declaration of Joint CSIR-UGC Test result, i.e. by 03.02.2023, whichever is later.

This is an electronic certificate only, its authenticity and category in which the candidate had appeared should be verified from National Testing Agency (NTA) by the institution/appointing authority. This electronic certificate can also be verified by scanning the QR Code.

The validity of this electronic certificate is forever.

Date of issue: 01.04.2021

Senior Director, NTA

Note: NTA has issued the electronic certificate on the basis of information provided by the candidate in his/her online Application Form. The appointing authority should verify the original records/certificates of the candidate while considering him/her for appointment, as the NTA will not be liable for any false information provided by the candidate. The NTA is only responsible for the result which can be verified from the repository available in the website of NTA (csirnet.nta.nic.in). The candidate must fulfil the minimum eligibility conditions as laid down in the notification for Joint CSIR-UGC Test.</td>
</tr>
</table>

BUBUN DAS
BSc Mathematics :
NET -LS
JUNE -2020
ROLL NO-
WB10606513
Mob: 8145359009

Ministry of Education
Government of India

Human Resource Development Group
Council of Scientific & Industrial Research

NATIONAL TESTING AGENCY

Joint CSIR - UGC NET JUNE 2020
National Testing Agency - Score Card /Result

Application Number :	201610105338	**Roll Number** :	WB10606513
Candidate's Name :	BUBUN DAS		
Mother's Name :	ANJANA DAS		
Father's Name :	SAKTI PADA DAS		
Category :	GENERAL	**Person with Disability(PwD)** :	No
Gender :	MALE	**Date of Birth** :	05-06-1995
Subject :	MATHEMATICAL SCIENCES		
No of Candidates in this Subject	**Registered** : 48266	**Appeared** :	31144
Applied For :	APPLIED FOR JRF		

Marks Obtained

Part A	8.500
Part B	54.000
Part C	42.750
Total Marks Obtained	105.250
Total Marks Obtained (in words)	ONE HUNDRED FIVE POINT TWO FIVE ZERO ONLY
Result	Lectureship/Assistant Professor
RANK	50

Dated : 28.12.2020 **Senior Director, NTA**

Note:

1. This electronically generated Score Card is the official score declared by NTA and does not require any signature.
2. Candidate's particulars including Category and Person with Disability (PwD) have been indicated as mentioned by the candidate in the online Application Form
3. The National Testing Agency has taken due care while uploading the Score Card. However, in case of any inadvertent error, the NTA reserves the right to rectify the same at a later stage.
4. No separate intimation about score card shall be issued.
5. Instructions relating to issuance/obtaining Eligibility Certificate to qualified candidates will be notified separately later by CSIR on their website www.csirhrdg.res.in.

SUNAYANI MONDAL
MSc Mathematics :2020
JRF-NET 2021
AIR :220
Roll No: UP18001741
Mob: 9083962561

NATIONAL TESTING AGENCY

Excellence in Assessment

E-certificate No.: JUN21C06608

University Grants Commission

JOINT CSIR-UGC TEST

NATIONAL ELIGIBILITY TEST FOR ASSISTANT PROFESSOR

NTA Ref. No: 211610026819 Roll No: UP18001741

Certified that SUNAYANI MONDAL

Son/Daughter of ASHIMA MONDAL

and SUSANTA MONDAL *has qualified*

in June 2021 Joint CSIR-UGC Test for eligibility for Assistant Professor in the subject

Mathematical Sciences

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This is an electronic certificate only, its authenticity and category in which the candidate had appeared should be verified from National Testing Agency (NTA) by the institution/appointing authority. This electronic certificate can also be verified by scanning the QR Code.

The validity of this electronic certificate is forever.

Date of issue: 19.04.2022

Senior Director, NTA

Note: NTA has issued the electronic certificate on the basis of information provided by the candidate in his/her online Application Form. The appointing authority should verify the original records/certificates of the candidate while considering him/her for appointment, as the NTA will not be liable for any false information provided by the candidate. The NTA is only responsible for the result which can be verified from the repository available in the website of NTA (csirnet.nta.nic.in). The candidate must fulfil the minimum eligibility conditions as laid down in the notification for Joint CSIR-UGC Test.

SUBHASISH DAS
GATE 2021 (Mathematics)
Reg. No: MA21S56042274
Mob: 7063765207

GATE 2021 Result [MA]

Name
SUBHASISH DAS

Registration Number
MA21S56042274

Gender
Male

Subhasish Das

Parent's/Guardian's name
TAPAN DAS

Date of birth
11-November-1996

Examination Paper
Mathematics (MA)

Marks out of 100#	33.67	All India Rank in this paper	976
Qualifying Marks##	29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)	GATE Score	435

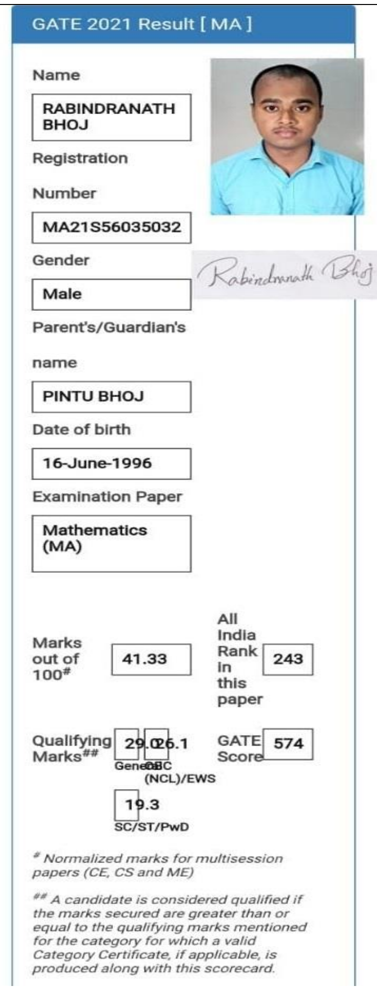
 # Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

Note:

- The marks and score provided here are for information only.
- An electronic or paper copy of this document is not valid.
- The official GATE 2021 Score Card can be downloaded from the GOAPS site between March 30, 2021 and June 30, 2021.
- From July 1, 2021 to December 31, 2021, the GATE 2021 Scorecard can be downloaded from GOAPS portal by paying a fee of INR 500/-. From January 1, 2022, the GATE 2021 Scorecard will NOT be available.
- The GATE 2021 Scorecard will be available ONLY for the candidates who have secured marks more than or equal to the qualifying marks mentioned for SC/ST/PwD category of that paper. All other candidates will NOT get any scorecard of GATE 2021.
- For the papers CE, CS and ME, qualifying marks and score are based on the "Normalized Marks".

Rabindranath Bhoj
GATE-2021
Reg No-MA21S56035032
All India Rank: 243
M.Sc Mathematics
Pass out: 2020



GATE 2021 Result [MA]

Name	RABINDRANATH BHOJ
Registration Number	MA21S56035032
Gender	Male
Parent's/Guardian's name	PINTU BHOJ
Date of birth	16-June-1996
Examination Paper	Mathematics (MA)
Marks out of 100#	41.33
All India Rank in this paper	243
Qualifying Marks##	29.0 General; 26.1 OBC (NCL)/EWS; 19.3 SC/ST/PwD
GATE Score	574

Rabindranath Bhoj

\# Normalized marks for multisession papers (CE, CS and ME)

\## A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

SANDIP DAS
GATE-2021
Reg No-MA21S56035152
All India Rank: 1326
M.Sc Mathematics
Pass out: 2020

GATE 2021 Result [MA]

Name

SANDIP DAS

Registration Number

MA21S56035152

Gender

Male

Parent's/Guardian's name

SUBHAS CHANDRA DAS

Date of birth

10-November-1996

Examination Paper

Mathematics (MA)

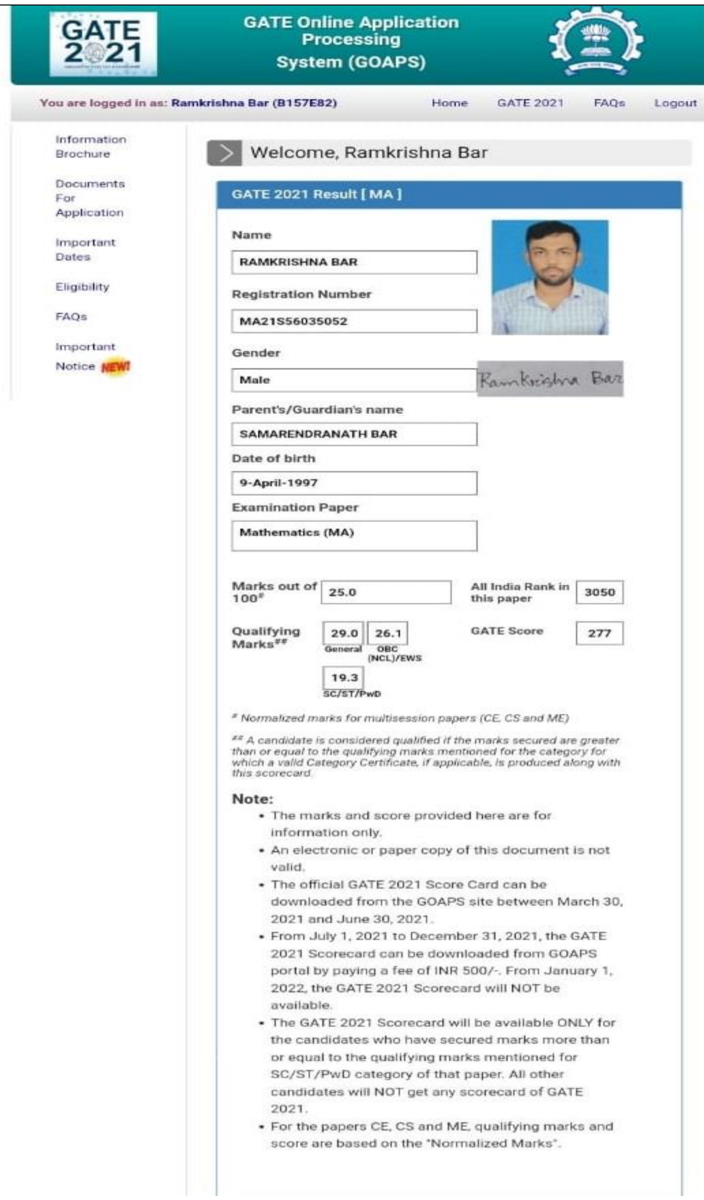
Marks out of 100# 31.67

All India Rank in this paper 1326

Qualifying Marks## 29.0 26.1

GATE Score 399

Sandip Das

Ramkrishna Bar GATE 2021(Mathematics) MA21S56035052 AIR-3050	

GATE 2021

GATE Online Application Processing System (GOAPS)

You are logged in as: Ramkrishna Bar (B157E82) Home GATE 2021 FAQs Logout

Information Brochure

Documents For Application

Important Dates

Eligibility

FAQs

Important Notice NEW!

Welcome, Ramkrishna Bar

GATE 2021 Result [MA]

Name: RAMKRISHNA BAR

Registration Number: MA21S56035052

Gender: Male

Ramkrishna Bar

Parent's/Guardian's name: SAMARENDRANATH BAR

Date of birth: 9-April-1997

Examination Paper: Mathematics (MA)

Marks out of 100#	25.0	All India Rank in this paper	3050
Qualifying Marks##	29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)	GATE Score	277

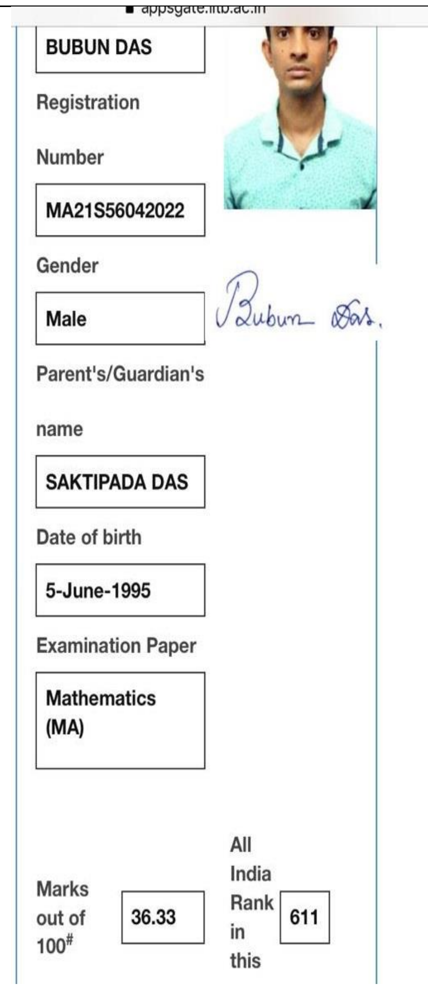
Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

Note:

- The marks and score provided here are for information only.
- An electronic or paper copy of this document is not valid.
- The official GATE 2021 Score Card can be downloaded from the GOAPS site between March 30, 2021 and June 30, 2021.
- From July 1, 2021 to December 31, 2021, the GATE 2021 Scorecard can be downloaded from GOAPS portal by paying a fee of INR 500/-. From January 1, 2022, the GATE 2021 Scorecard will NOT be available.
- The GATE 2021 Scorecard will be available ONLY for the candidates who have secured marks more than or equal to the qualifying marks mentioned for SC/ST/PwD category of that paper. All other candidates will NOT get any scorecard of GATE 2021.
- For the papers CE, CS and ME, qualifying marks and score are based on the "Normalized Marks".

BUBUN DAS
Reg no-MA21S56042022
All India Rank: 611
M.Sc Mathematics
Pass out:
Mob:8145359009



appsgate.iitb.ac.in

BUBUN DAS

Registration Number

MA21S56042022

Gender

Male

Parent's/Guardian's name

SAKTIPADA DAS

Date of birth

5-June-1995

Examination Paper

Mathematics (MA)

Marks out of 100#: 36.33

All India Rank in this: 611

SUKHENDU DAS ADHIKARY

GATE-2021
Reg No-MA21S56036019
All India Rank: 1206
M.Sc Mathematics
Pass out: 2020
Mob:

GATE 2021 Result [MA]

Name
SUKHENDU DAS ADHIKARY

Registration Number
MA21S56036019

Gender
Male

Sukhendu Das Adhikary

Parent's/Guardian's name
KENARAM DAS ADHIKARY

Date of birth
15-July-1996

Examination Paper
Mathematics (MA)

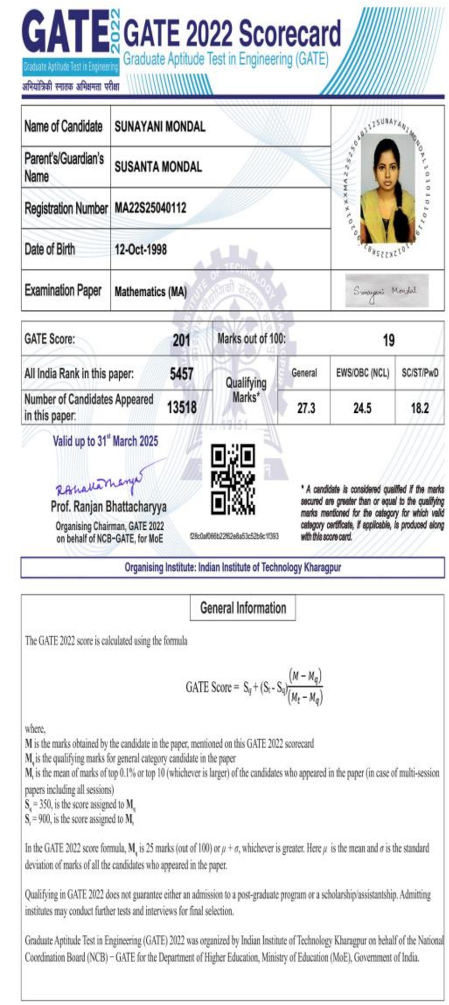
Marks out of 100#	32.33	All India Rank in this paper	1206
Qualifying Marks##	29.0 (General), 26.1 (OBC (NCL)/EWS), 19.3 (SC/ST/PwD)	GATE Score	411

Normalized marks for multisession papers (CE, CS and ME)

A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which a valid Category Certificate, if applicable, is produced along with this scorecard.

SUNAYANI MONDAL
MSc Mathematics :2020
GATE (MA) 2022
MA21S56033041

Mob: 9083962561
AIR-5457



GATE 2022 GATE 2022 Scorecard
Graduate Aptitude Test in Engineering (GATE)
Graduate Aptitude Test in Engineering
अभियांत्रिकी स्नातक अभिक्षमता परीक्षा

Name of Candidate	SUNAYANI MONDAL
Parent's/Guardian's Name	SUSANTA MONDAL
Registration Number	MA22S25040112
Date of Birth	12-Oct-1998
Examination Paper	Mathematics (MA)

GATE Score:	201	Marks out of 100:	19		
All India Rank in this paper:	5457	Qualifying Marks*	General	EWS/OBC (NCL)	SC/ST/PwD
Number of Candidates Appeared in this paper:	13518		27.3	24.5	18.2

Valid up to 31st March 2025

Prof. Ranjan Bhattacharyya
Organising Chairman, GATE 2022
on behalf of NCB–GATE, for MoE

* A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which valid category certificate, if applicable, is produced along with this score card.

Organising Institute: Indian Institute of Technology Kharagpur

General Information

The GATE 2022 score is calculated using the formula

$$\text{GATE Score} = S_q + (S_t - S_q)\frac{(M - M_q)}{(M_t - M_q)}$$

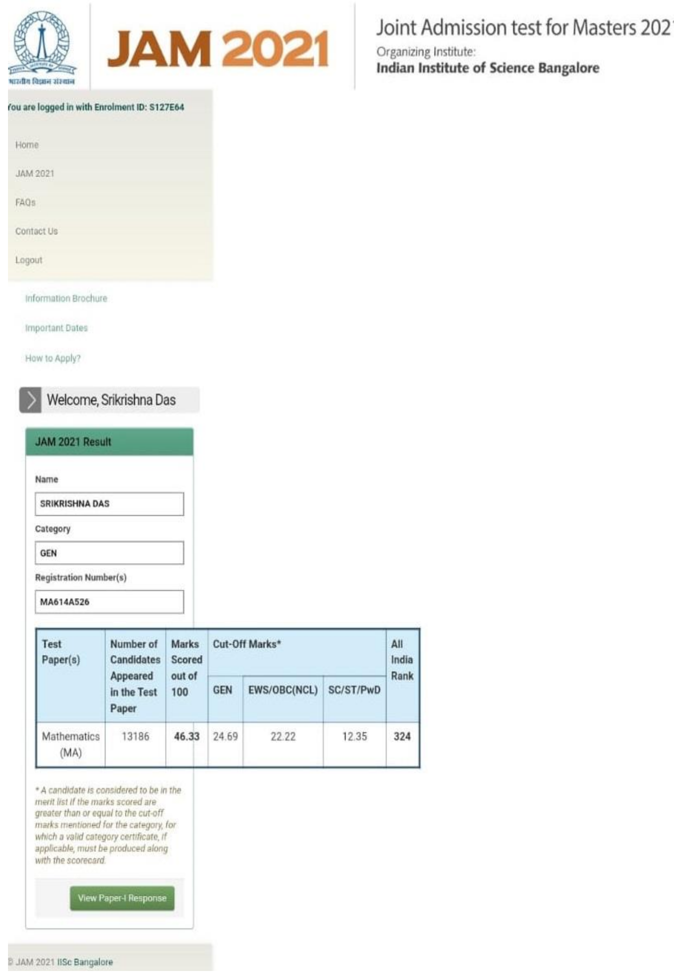
where,
M is the marks obtained by the candidate in the paper, mentioned on this GATE 2022 scorecard
M_q is the qualifying marks for general category candidate in the paper
M_t is the mean of marks of top 0.1% or top 10 (whichever is larger) of the candidates who appeared in the paper (in case of multi-session papers including all sessions)
S_q = 350, is the score assigned to M_q
S_t = 900, is the score assigned to M_t

In the GATE 2022 score formula, M_q is 25 marks (out of 100) or $\mu + \sigma$, whichever is greater. Here μ is the mean and σ is the standard deviation of marks of all the candidates who appeared in the paper.

Qualifying in GATE 2022 does not guarantee either an admission to a post-graduate program or a scholarship/assistantship. Admitting institutes may conduct further tests and interviews for final selection.

Graduate Aptitude Test in Engineering (GATE) 2022 was organized by Indian Institute of Technology Kharagpur on behalf of the National Coordination Board (NCB) – GATE for the Department of Higher Education, Ministry of Education (MoE), Government of India.

SRIKRISHNA DAS
JAM(MA): 2021
Reg. No. MA614A526
AIR-324



JAM 2021

Joint Admission test for Masters 202

Organizing Institute:
Indian Institute of Science Bangalore

You are logged in with Enrolment ID: S127E64

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JAM 2021
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Important Dates
How to Apply?

Welcome, Srikrishna Das

JAM 2021 Result

Name: SRIKRISHNA DAS

Category: GEN

Registration Number(s): MA614A526

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	EWS/OBC(NCL)	SC/ST/PwD	
Mathematics (MA)	13186	**46.33**	24.69	22.22	12.35	**324**

** A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the scorecard.*

View Paper-I Response

© JAM 2021 IISc Bangalore

SUBHADIP SAHOO
JAM (MA) 2021
Reg. No. : MA613A243
AIR-1094

JAM 2021

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Important Dates

How to Apply?

Welcome, Subhadip Sahoo

JAM 2021 Result

Name

SUBHADIP SAHOO

Category

GEN

Registration Number(s)

MA613A243

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	EWS/OBC(NCL)	SC/ST/PwD	
Mathematics (MA)	13186	**32.67**	24.69	22.22	12.35	**1094**

** A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the scorecard.*

View Paper-I Response

Digital Finger-Print:
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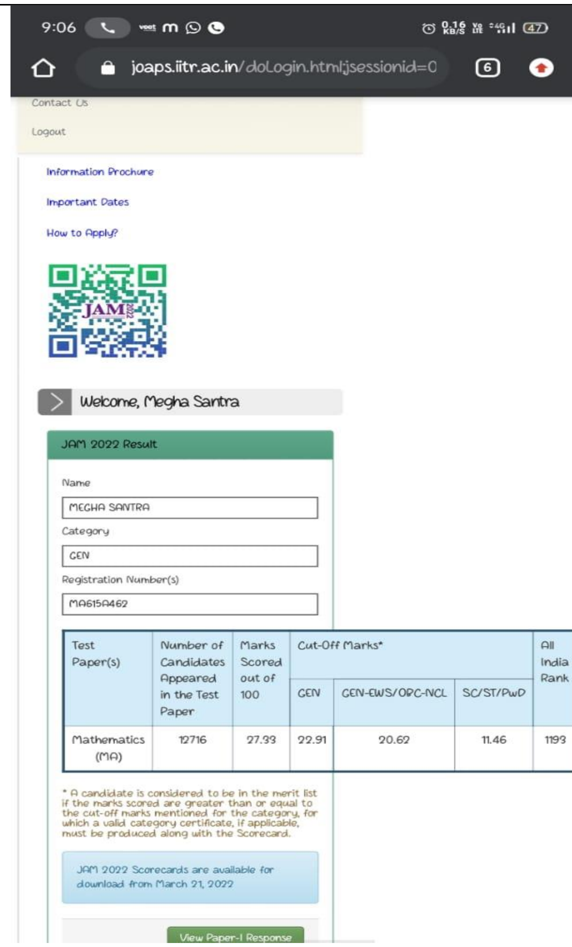
Megha Santra
JAM (MA) : 2022
Reg. No. : MA615A462

AIR-1193


9:06
joaps.iitr.ac.in/doLogin.html;jsessionid=0
Contact Us
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Important Dates
How to Apply?
Welcome, Megha Santra
JAM 2022 Result
Name
MEGHA SANTRA
Category
GEN
Registration Number(s)
MA615A462

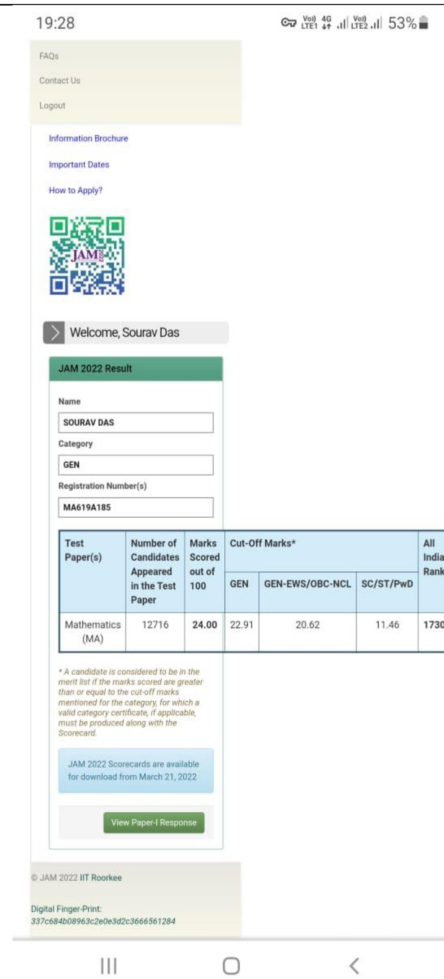
Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	GEN-EWS/OBC-NCL	SC/ST/PwD	
Mathematics (MA)	12716	27.33	22.91	20.62	11.46	1193

* A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the Scorecard.

JAM 2022 Scorecards are available for download from March 21, 2022

View Paper-I Response

Anwesha Samanta JAM(MA): 2022 MA615A182 AIR-1554	

Sourav Das JAM (MA): 2022 Reg. No.-MA619A185 ALL INDIA RANK:1730	

19:28 53%

FAQs
Contact Us
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Information Brochure
Important Dates
How to Apply?

Welcome, Sourav Das

JAM 2022 Result

Name
SOURAV DAS
Category
GEN
Registration Number(s)
MA619A185

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	GEN-EWS/OBC-NCL	SC/ST/PwD	
Mathematics (MA)	12716	**24.00**	22.91	20.62	11.46	**1730**

** A candidate is considered to be in the merit list if the marks scored are greater than or equal to the cut-off marks mentioned for the category, for which a valid category certificate, if applicable, must be produced along with the Scorecard.*

JAM 2022 Scorecards are available for download from March 21, 2022

View Paper-I Response

© JAM 2022 IIT Roorkee

Digital Finger-Print:
337c684b08963c2e0e3d2c3666561284

Bithi Maikap
JAM (MA): 2022
Reg No. -MA614A021
AIR:5468
Mob:

JAM 2022 Result

Name

BITHI MAIKAP

Category

GEN

PwD Status

Yes

Registration Number(s)

MA614A021

Test Paper(s)	Number of Candidates Appeared in the Test Paper	Marks Scored out of 100	Cut-Off Marks*			All India Rank
			GEN	GEN-EWS/OBC-NCL	SC/ST/PwD	
Mathematics (MA)	12716	**13.67**	22.91	20.62	11.46	**5468**

* A candidate is considered

RABINDRANATH BHOJ
M.Sc.: 2020
GATE(MA)-2022
Reg No-MA22S26507319
AIR: 487

GATE 2022 Scorecard

Graduate Aptitude Test in Engineering (GATE)

Name of Candidate	RABINDRANATH BHOJ
Parent's/Guardian's Name	PINTU BHOJ
Registration Number	MA22S26507319
Date of Birth	16-Jun-1996
Examination Paper	Mathematics (MA)

GATE Score:	518	Marks out of 100:		36.67
All India Rank in this paper:	487	Qualifying Marks*	General	EWS/OBC (NCL)
Number of Candidates Appeared in this paper:	13518		27.3	24.5

Valid up to 31st March 2025

Prof. Ranjan Bhattacharyya
Organising Chairman, GATE 2022
on behalf of NCB-GATE, for MoE

* A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category ... category certificate, if applicable, ... with this score card.

Organising Institute: Indian Institute of Technology Kharagpur

General Information

The GATE 2022 score is calculated using the formula

$$\text{GATE Score} = S_q + (S_t - S_q)\frac{(M - M_q)}{(M_t - M_q)}$$

where,
M is the marks obtained by the candidate in the paper, mentioned on this GATE 2022 scorecard
M_q is the qualifying marks for general category candidate in the paper
M_t is the mean of marks of top 0.1% or top 10 (whichever is larger) of the candidates who appeared in the paper (in case of ... papers including all sessions)
S_q = 350, is the score assigned to M_q
S_t = 900, is the score assigned to M_t

Sukhendu Das Adhikary
M.Sc.-
GATE(MA): 2022
Reg No: MA22S26507537

GATE 2022 Scorecard

Graduate Aptitude Test in Engineering (GATE)

Name of Candidate	SUKHENDU DAS ADHIKARY	
Parent's/Guardian's Name	KENARAM DAS ADHIKARY	
Registration Number	MA22S26507537	
Date of Birth	15-Jul-1996	
Examination Paper	Mathematics (MA)	

GATE Score:	440	Marks out of 100:		32.33	
All India Rank in this paper:	1007	Qualifying Marks*	General	EWS/OBC (NCL)	SC/ST/PwD
Number of Candidates Appeared in this paper:	13518		27.3	24.5	18.2

Valid up to 31st March 2025

Prof. Ranjan Bhattacharyya
Organising Chairman, GATE 2022
on behalf of NCB-GATE, for MoE

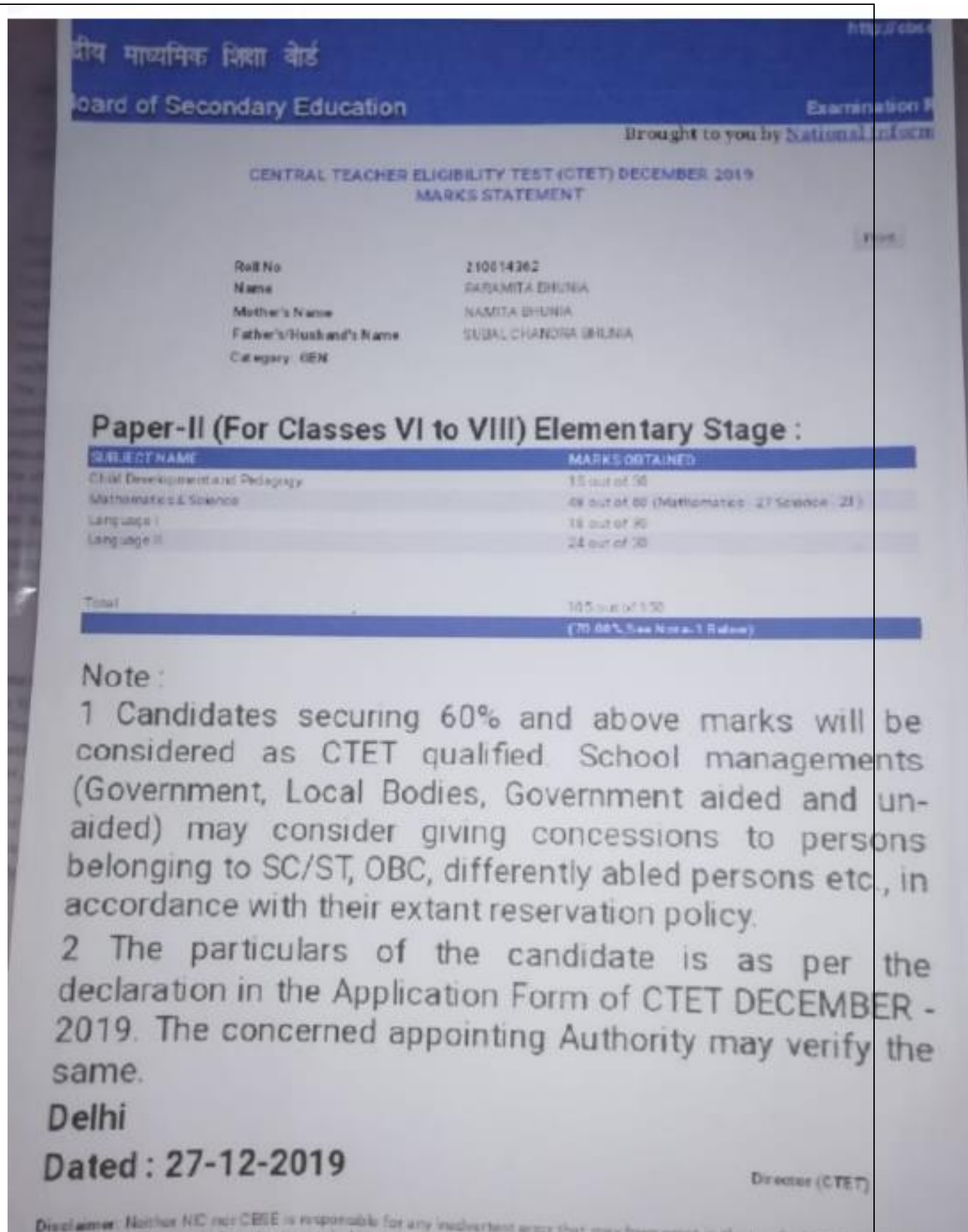
* A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which valid category certificate, if applicable, is produced along with this score card.

Organising Institute: Indian Institute of Technology Kharagpur

General Information

The GATE 2022 score is calculated using the formula

$$\text{GATE Score} = S_q + (S_t - S_q)\frac{(M - M_q)}{(M_t - M_q)}$$

PARAMITA BHUNIA ROLL NO- **210014362** **CTET**	

रीय माध्यमिक शिक्षा बोर्ड

oard of Secondary Education

Examination R

Brought to you by National Inform

CENTRAL TEACHER ELIGIBILITY TEST (CTET) DECEMBER 2019
MARKS STATEMENT

Print

Roll No	210014362
Name	PARAMITA BHUNIA
Mother's Name	NAMITA BHUNIA
Father's/Husband's Name	SUBAL CHANDRA BHUNIA
Category : GEN	

Paper-II (For Classes VI to VIII) Elementary Stage :

SUBJECT NAME	MARKS OBTAINED
Child Development and Pedagogy	15 out of 30
Mathematics & Science	48 out of 60 (Mathematics : 27 Science : 21)
Language I	18 out of 30
Language II	24 out of 30
Total	105 out of 150
	(70.00% See Note-1 Below)

Note :

1 Candidates securing 60% and above marks will be considered as CTET qualified. School managements (Government, Local Bodies, Government aided and un-aided) may consider giving concessions to persons belonging to SC/ST, OBC, differently abled persons etc., in accordance with their extant reservation policy.

2 The particulars of the candidate is as per the declaration in the Application Form of CTET DECEMBER - 2019. The concerned appointing Authority may verify the same.

Delhi

Dated : 27-12-2019

Director (CTET)

Disclaimer: Neither NIC nor CBSE is responsible for any inadvertent error that may have crept in the results ...

MANISH ACHARYYA
M.Sc.-
GATE (MA): 2022
Reg. No.-MA22S26507527
AIR-1195

GATE 2022 GATE 2022 Scorecard

Graduate Aptitude Test in Engineering (GATE)

Graduate Aptitude Test in Engineering
अभियांत्रिकी स्नातक अभिक्षमता परीक्षा

Name of Candidate	**MANISH ACHARYYA**
Parent's/Guardian's Name	**KRISHNADAS ACHARYYA**
Registration Number	**MA22S26507527**
Date of Birth	**18-Apr-1999**
Examination Paper	**Mathematics (MA)**

Manish Acharyya.

GATE Score:	**422**	Marks out of 100:		**31.33**	
All India Rank in this paper:	**1195**	Qualifying Marks*	General	EWS/OBC (NCL)	SC/ST/PwD
Number of Candidates Appeared in this paper:	**13518**		**27.3**	**24.5**	**18.2**

Valid up to 31st March 2025

RBhattacharya
Prof. Ranjan Bhattacharyya
Organising Chairman, GATE 2022
on behalf of NCB–GATE, for MoE

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** A candidate is considered qualified if the marks secured are greater than or equal to the qualifying marks mentioned for the category for which valid category certificate, if applicable, is produced along with this score card.*

Organising Institute: Indian Institute of Technology Kharagpur

Subhasish Das Roll No (CTET): 173160811630157	केन्द्रीय माध्यमिक शिक्षा बोर्ड Central Board of Secondary Education http://cbseresults.nic.in Examination Results 2021 Brought to you by National Informatics Centre **CENTRAL TEACHER ELIGIBILITY TEST (CTET) DECEMBER 2021** **MARKS STATEMENT** **Roll No** **173160811630157** **Name** SUBHASISH DAS **Mother's Name** SABITRI DAS **Father's/Husband's Name** TAPAN DAS **Category : GEN** **Paper-I (For Classes I to V) Primary Stage :** SUBJECT NAME — MARKS OBTAINED Child Development and Pedagogy — 28 out of 30 Mathematics — 27 out of 30 Environmental Studies — 20 out of 30 Language I — 23 out of 30 Language II — 16 out of 30 Total — 114 out of 150 (76.00%,See Note-1 Below) **Paper-II (For Classes VI to VIII) Elementary Stage :** SUBJECT NAME — MARKS OBTAINED Child Development and Pedagogy — 27 out of 30 Mathematics & Science — 41 out of 60 (Mathematics - 23 Science - 18)	

Rabindranath Bhoj
M.Sc. 2020
CSIR-JRF (Math)- Jne2022
Roll No. WB1011240136

NATIONAL TESTING AGENCY
Excellence in Assessment
(उच्चतर शिक्षा विभाग, शिक्षा मंत्रालय
भारत सरकार के तहत एक स्वायत्त संगठन)
(An Autonomous Org. under the Dept. of Higher Edu.
Ministry of Education, Govt. of India)

विश्वविद्यालय अनुदान आयोग

First Floor, NSIC-MDBP Building, Okhla Industrial Estate, New Delhi, Delhi 110020 (India), Phone: 011-69227700, 011-40759000

Joint CSIR-UGC Test
JRF AWARD LETTER

Dated: **29.11.2022**

NTA Ref. No.: **221610159628**

Roll No.: **WB1011240136**

RABINDRANATH BHOJ
Son/Daughter of **ANITA BHOJ**
and **PINTU BHOJ**
Subject: **MATHEMATICAL SCIENCES**

Dear Candidate,

I am pleased to inform you that you have qualified for Junior Research Fellowship (JRF) and eligibility for Assistant Professor in June 2022 Joint CSIR-UGC TEST. The tenure of fellowship is five years and it commences from the date of declaration of NET result, i.e., **28-10-2022** *(or) from the date of admission under M.Phil./Ph.D. (or) from the date of joining M.Phil./Ph.D. programme, whichever is later. The summary of financial assistance offered under the scheme is mentioned at* ***Annexure I*** *available on www.ugc.ac.in/netjrf* along with other Annexures.

The Awardee is required to get admission and registration for regular and full time ***M.Phil./Ph.D.*** *course in a University/Institution/College recognized by UGC at the first available opportunity* ***but not later than three years*** *from the date of issue of original award letter, i.e., . University/Institution/College is requested to process for award of JRF based on this letter, in accordance with the procedure available on www.ugc.ac.in/netjrf.*

It may be noted that the fellowship amount shall be disbursed through Canara Bank to bank account of the Awardee (any bank) directly. UGC had developed a dedicated web portal (https://scholarship.canarabank.in) for capturing data of the awardee. The Universities/Colleges/Institutions will link the data of the awardee with the master data on the UGC web portal with unique Maker/Checker Ids which have already been provided to them along with the passwords. The Universities/Colleges/Institutions shall update the information in the master data (regarding monthly payment confirmation, HRA, up-gradation, resignation etc.) of the beneficiaries on monthly basis. Based on the data updated on UGC web portal by the concerned Universities/Colleges/Institutions, the payment of the fellowship will be made to the beneficiaries (Detailed process available at https://www.ugc.ac.in/ugc_notices.aspx?id=2153).

It may also be noted that UGC had proposed to link ***"AADHAAR"*** *with bank account of students so that there can be direct cash transfer and effective disbursal of fellowship into bank account of the student. In this regard, Secretary, UGC had requested the universities to help students in Aadhaar enrolment vide D.O. No. F.14-34/2011 (CPP-II) dated 11.01.2013.*

It may please be noted that the award is liable to be cancelled by Implementing/Awarding agency and it will also attract legal action against the Awardee in the following cases:

Tushar Kanti Bera

Roll No (CTET) : 173160811631684

CENTRAL BOARD OF SECONDARY EDUCATION, DELHI

Central Teacher Eligibility Test (CTET) - DECEMBER 2021

Eligibility Certificate

This is to certify that

Name	TUSHAR KANTI BERA
Roll No.	173160811631684
Category	GEN
Mother's Name	SILA BERA
Father's/Husband's Name	SANKAR KUMAR BERA

appeared at Central Teacher Eligibility Test conducted by Central Board of Secondary Education, Delhi and performed as under:-

Paper-I (For Classes I-V) Primary Stage			Paper-II (For Classes VI-VIII) Elementary Stage		
Subject	Maximum Marks	Marks Obtained	Subject	Maximum Marks	Marks Obtained
Child Development and Pedagogy	30	19	Child Development and Pedagogy	30	17
Mathematics	30	20	Mathematics & Science (Maths :19 & Science :16)	60	35
Environmental Studies	30	18			
Language-I Bengali	30	19	Language-I Bengali	30	15
Language-II English	30	15	Language-II English	30	12
Total Marks	150	091	Total Marks	150	079
Result	**QUALIFIED**		Result	**NOT QUALIFIED**	
Examination held on :	**Paper-I: 21-01-2022, Paper-II: 21-01-2022**		Result declared on :	**09-03-2022**	

DELHI

DATE : 09-03-2022

DigiLocker Verified

Digitally signed by:
Authorized Signatory
Central Board of Secondary Education
Date: 23/05/2022 10:10:17 IST

SUKHENDU DAS ADHIKARY
MSc: 2019

Roll No : WB07000340
NET-JRF

NATIONAL TESTING AGENCY
Excellence in Assessment
(उच्चतर शिक्षा विभाग, शिक्षा मंत्रालय
भारत सरकार के तहत एक स्वायत्त संगठन)
(An Autonomous Org. under the Dept. of Higher Edu.
Ministry of Education, Govt. of India)

विश्वविद्यालय अनुदान आयोग

First Floor, NSIC-MDBP Building, Okhla Industrial Estate, New Delhi, Delhi 110020 (India), Phone: 011-69227700, 011-40759000

Joint CSIR-UGC Test
JRF AWARD LETTER

Dated: **19.04.2022**

NTA Ref. No.: **211610078837**
Roll No.: **WB07000340**

SUKHENDU DAS ADHIKARY
Son/Daughter of **NIRMALA DAS ADHIKARY**
and **KENARAM DAS ADHIKARY**
Subject: **MATHEMATICAL SCIENCES**

Dear Candidate,

*I am pleased to inform you that you have qualified for Junior Research Fellowship (JRF) and eligibility for Assistant Professor in June 2021 Joint CSIR-UGC TEST. The tenure of fellowship is five years and it commences from the date of declaration of NET result, i.e., **24.03.2022** (or) from the date of admission under M.Phil./Ph.D. (or) from the date of joining M.Phil./Ph.D. programme, whichever is later. The summary of financial assistance offered under the scheme is mentioned at **Annexure I** available on www.ugc.ac.in/netjrf* along with other Annexures.

*The Awardee is required to get admission and registration for regular and full time **M.Phil./Ph.D.** course in a University/Institution/College recognized by UGC at the first available opportunity **but not later than three years** from the date of issue of this award letter. University/Institution/College is requested to process for award of JRF based on this letter, in accordance with the procedure available on www.ugc.ac.in/netjrf.*

It may be noted that the fellowship amount shall be disbursed through Canara Bank to bank account of the Awardee (any bank) directly. UGC had developed a dedicated web portal (https://scholarship.canarabank.in) for capturing data of the awardee. The Universities/Colleges/Institutions will link the data of the awardee with the master data on the UGC web portal with unique Maker/Checker Ids which have already been provided to them along with the passwords. The Universities/Colleges/Institutions shall update the information in the master data (regarding monthly payment confirmation, HRA, up-gradation, resignation etc.) of the beneficiaries on monthly basis. Based on the data updated on UGC web portal by the concerned Universities/Colleges/Institutions, the payment of the fellowship will be made to the beneficiaries (Detailed process available at https://www.ugc.ac.in/ugc_notices.aspx?id=2153).

*It may also be noted that UGC had proposed to link **"AADHAAR"** with bank account of students so that there can be direct cash transfer and effective disbursal of fellowship into bank account of the student. In this regard, Secretary, UGC had requested the universities to help students in Aadhaar enrolment vide D.O. No. F.14-34/2011 (CPP-II) dated 11.01.2013.*

It may please be noted that the award is liable to be cancelled by Implementing/Awarding agency and it will also attract legal action against the Awardee in the following cases:

i. *If the awardee is found to be ineligible to receive the award at any point during the entire duration of fellowship,*
ii. *Misconduct of Awardee,*
iii. *Unsatisfactory progress of research work,*
iv. *Failure in any examination related to M.Phil./Ph.D.,*
v. *In case any other fellowship is drawn from other source(s),*
vi. *Concealment of facts.*

The e-Certificate of eligibility for Assistant Professor has been uploaded on https://ecertificate.nta.ac.in. The eligibility of the candidate is to be ensured by the concerned institution/appointing authority. The category under which the candidate had appeared may be verified from NTA.

This electronic JRF award letter can also be verified by scanning the QR Code.

With best wishes,

Senior Director, NTA

Note: NTA has issued the electronic JRF award letter on the basis of information provided by the candidate in his/her online application form. The appointing authority should verify the original records/certificates of the candidate while considering him/her for JRF award or appointment, as the NTA will not be liable for any false information provided by the candidate. The NTA is only responsible for the result which can be verified from the repository available in the website of NTA (csirnet.nta.nic.in). The candidate must fulfil the minimum eligibility conditions for NET as laid down in the notification for Joint CSIR-UGC Test.

5.2.3 Number of students qualifying in state/national/ international level examinations during the year (eg

Year	Registration number/roll number for the exam	Names of students selected/ qualified		
		NET	**SLET**	**GATE**
2022-23	WB1011240136	Rabindranath Bhoj		
2021-22	MA22S26507537			SUKHENDU DAS ADHIKARY
2021-22	MA22S26507537			Rabindranath Bhoj
2021-22	1.73161E+14			
2021-22	MA619A185			
2021-22	MA615A182			
2021-22	MA614A021			
2021-22	WB07000340	SUKHENDU DAS ADHIKARY		
2021-22	MA615A462			
2021-22	UP18001741	SUNAYANI MONDAL		
2021-22	MA22S26507527			Manish Acharyya
2020-21	WB10606188	SUKHENDU DAS ADHIKARY		
2020-21	MA21S56042274			Subhasish Das
2020-21	MA21S56035032			Rabindranath Bhoj
2020-21	MA21S56035152			Sandip Das
2020-21	MA21S56035052			Ramkrishna Bar
2020-21	MA21S56042022			Bubun Das
2020-21	MA21S56036019			Sukhendu Das Adhikary
2020-21	MA21S56033041			SUNAYANI MONDAL
2020-21	1.73161E+14			
2020-21	MA614A526			
2020-21	MA613A243			
2020-21	WB10606513	Bubun Das		
2018-19	**210014362**			
	Total	**5**		**10**

Instruction: Please do not include individual university's entrance examina

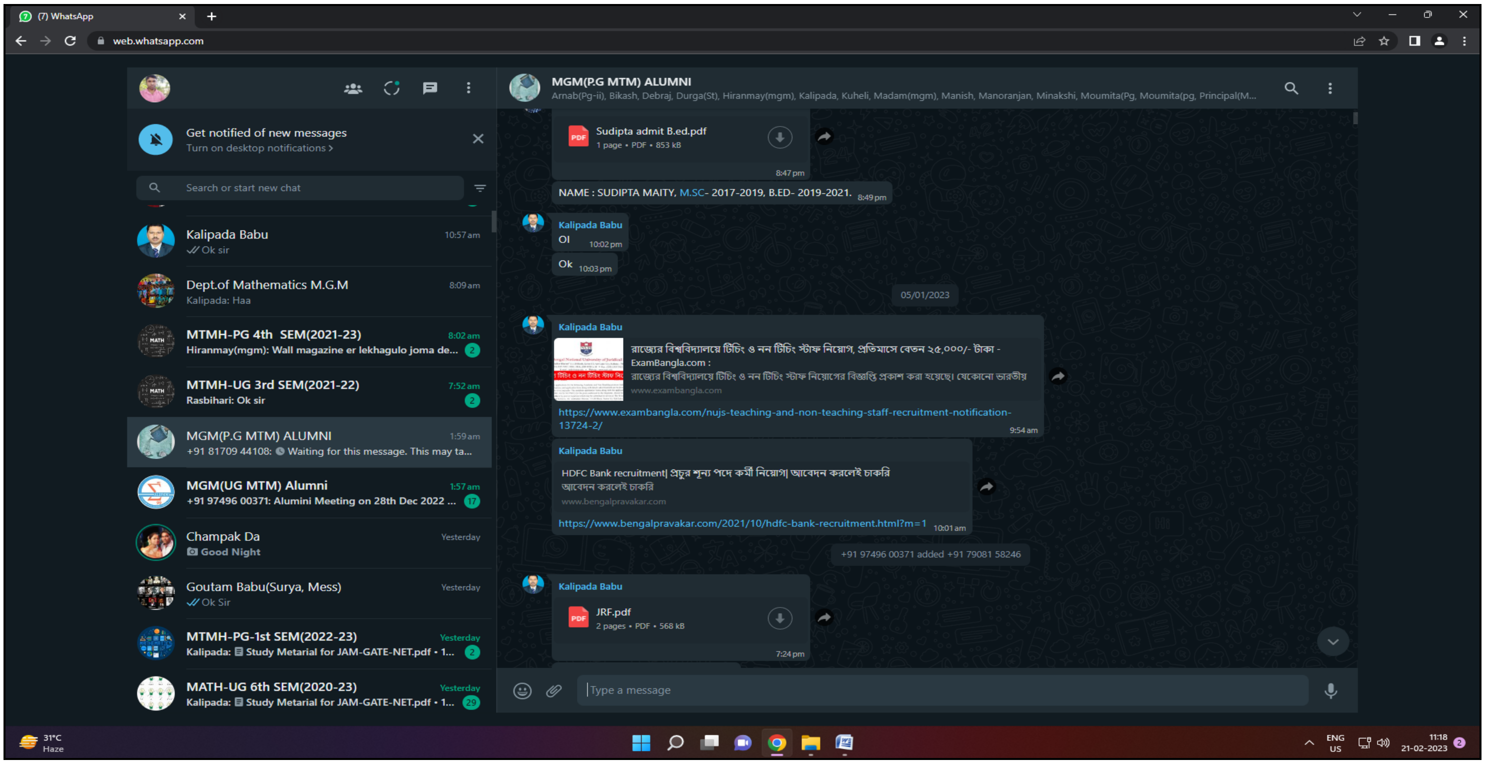
: JAM/GATE/ CLAT/GMAT/CAT/GRE/ TOEFL/ Civil Services/State government examinations, etc.)

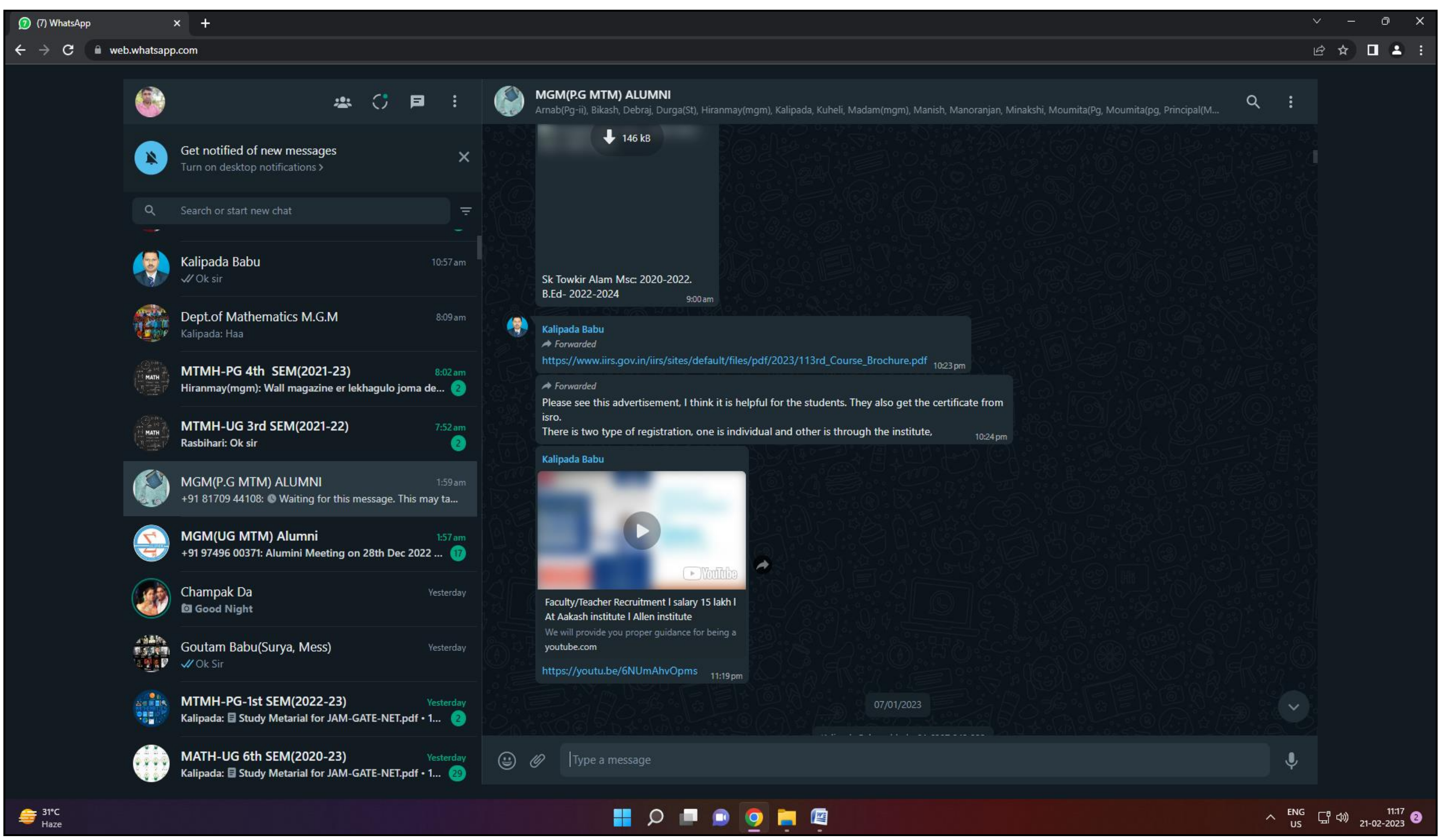
GMAT	**CAT**	**GRE**	**JAM**	**IELET**	**TOEFL**	**Civil Services**	**State government examinations**
			Sourav Das				
			Anwesha Samanta				
			Bithi Maikap				
			Megha Santra				
			Srikrishna Das				
			Subhadip Sahoo				
			6				

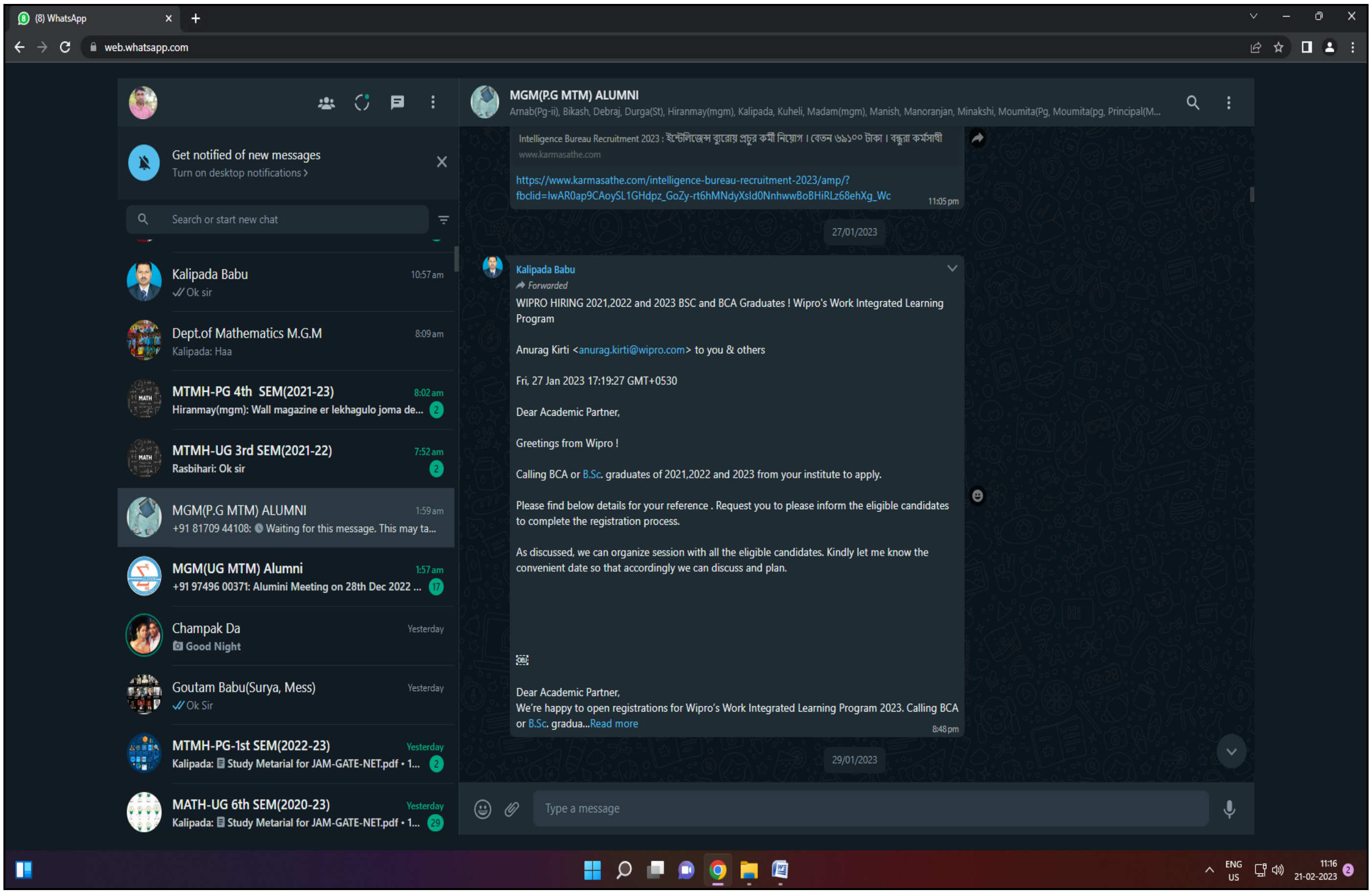
tion.

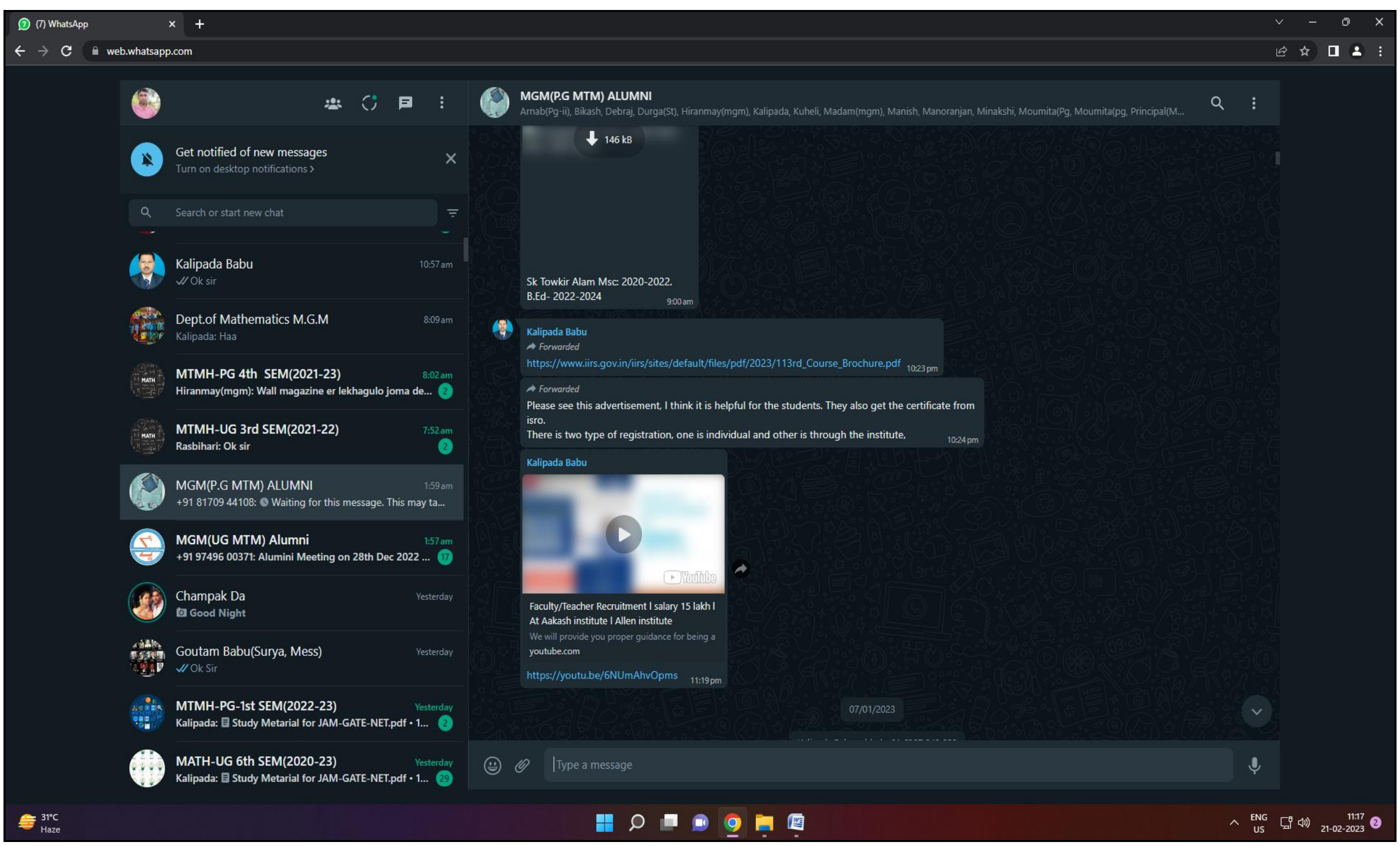
Other examinations conducted by the State / Central Government Agencies (Specify)		
Subhasish Das(CTET)		
Tushar Kanti Bera(CTET)		
Paramita Bhunia(CTET)		
3	**Grand Total**	**24**

Different kind of Advertisement in Mathematics Departmental Group






(8) WhatsApp
web.whatsapp.com
Get notified of new messages
Turn on desktop notifications >
Search or start new chat
Kalipada Babu 10:57 am
Ok sir
Dept.of Mathematics M.G.M 8:09 am
Kalipada: Haa
MTMH-PG 4th SEM(2021-23) 8:02 am
Hiranmay(mgm): Wall magazine er lekhagulo joma de...
MTMH-UG 3rd SEM(2021-22) 7:52 am
Rasbihari: Ok sir
MGM(P.G MTM) ALUMNI 1:59 am
+91 81709 44108: Waiting for this message. This may ta...
MGM(UG MTM) Alumni 1:57 am
+91 97496 00371: Alumini Meeting on 28th Dec 2022 ...
Champak Da Yesterday
Good Night
Goutam Babu(Surya, Mess) Yesterday
Ok Sir
MTMH-PG-1st SEM(2022-23) Yesterday
Kalipada: Study Metarial for JAM-GATE-NET.pdf • 1...
MATH-UG 6th SEM(2020-23) Yesterday
Kalipada: Study Metarial for JAM-GATE-NET.pdf • 1...
MGM(P.G MTM) ALUMNI
Arnab(Pg-ii), Bikash, Debraj, Durga(St), Hiranmay(mgm), Kalipada, Kuheli, Madam(mgm), Manish, Manoranjan, Minakshi, Moumita(Pg, Moumita(pg, Principal(M...
Intelligence Bureau Recruitment 2023 : ইন্টেলিজেন্স ব্যুরোয় প্রচুর কর্মী নিয়োগ। বেতন ৬৯১০০ টাকা। বহুরা কর্মসাথী
www.karmasathe.com
https://www.karmasathe.com/intelligence-bureau-recruitment-2023/amp/?fbclid=IwAR0ap9CAoySL1GHdpz_GoZy-rt6hMNdyXsId0NnhwwBoBHiRLz68ehXg_Wc 11:05 pm
27/01/2023
Kalipada Babu
Forwarded
WIPRO HIRING 2021,2022 and 2023 BSC and BCA Graduates ! Wipro's Work Integrated Learning Program
Anurag Kirti <anurag.kirti@wipro.com> to you & others
Fri, 27 Jan 2023 17:19:27 GMT+0530
Dear Academic Partner,
Greetings from Wipro !
Calling BCA or B.Sc. graduates of 2021,2022 and 2023 from your institute to apply.
Please find below details for your reference . Request you to please inform the eligible candidates to complete the registration process.
As discussed, we can organize session with all the eligible candidates. Kindly let me know the convenient date so that accordingly we can discuss and plan.
Dear Academic Partner,
We're happy to open registrations for Wipro's Work Integrated Learning Program 2023. Calling BCA or B.Sc. gradua...Read more 8:48 pm
29/01/2023
Type a message
ENG US 11:16 21-02-2023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Kalipada Babu 10:57 am
Ok sir
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Good Night
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Kalipada: Study Metarial for JAM-GATE-NET.pdf • 1...
MATH-UG 6th SEM(2020-23) Yesterday
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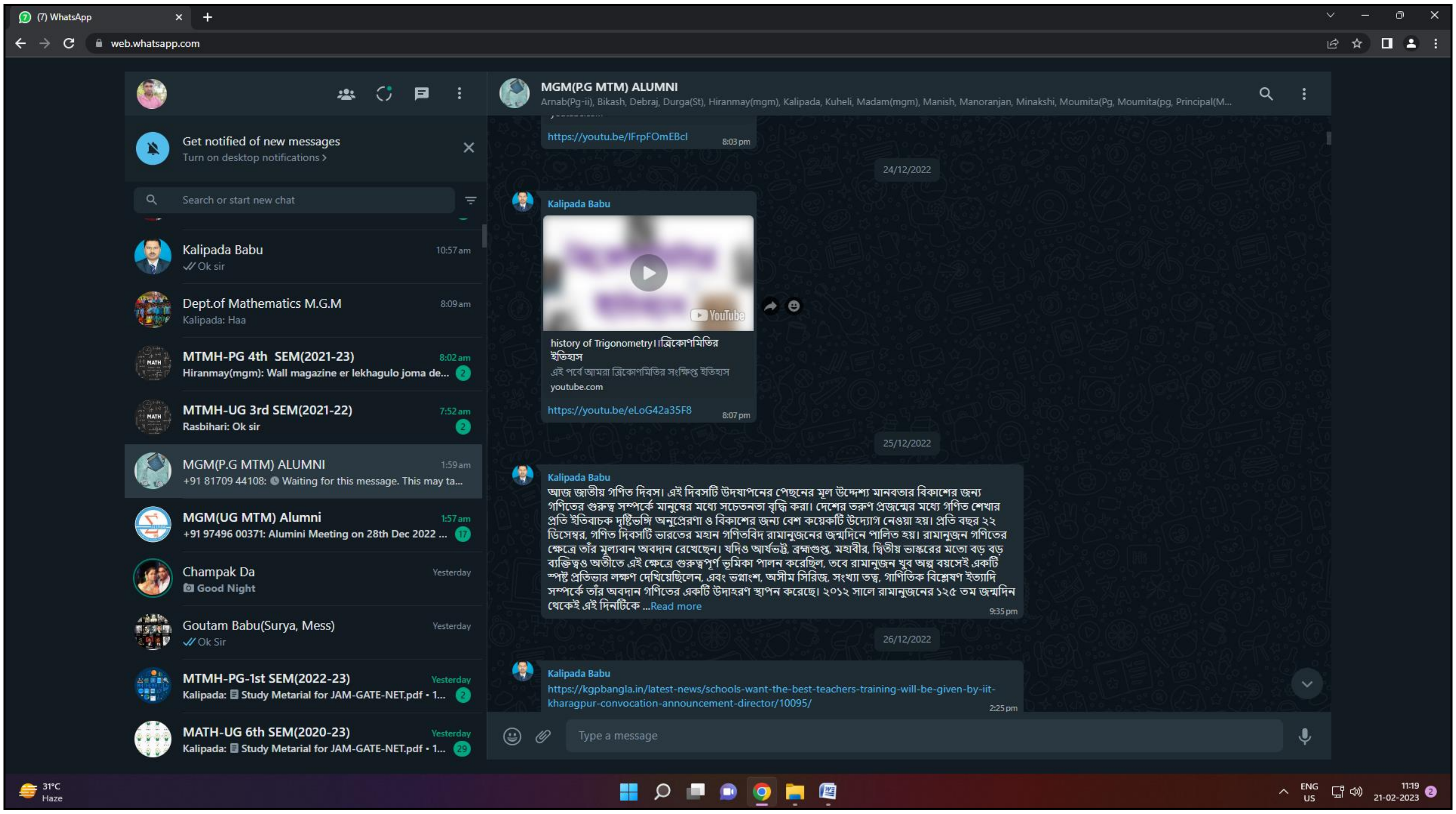
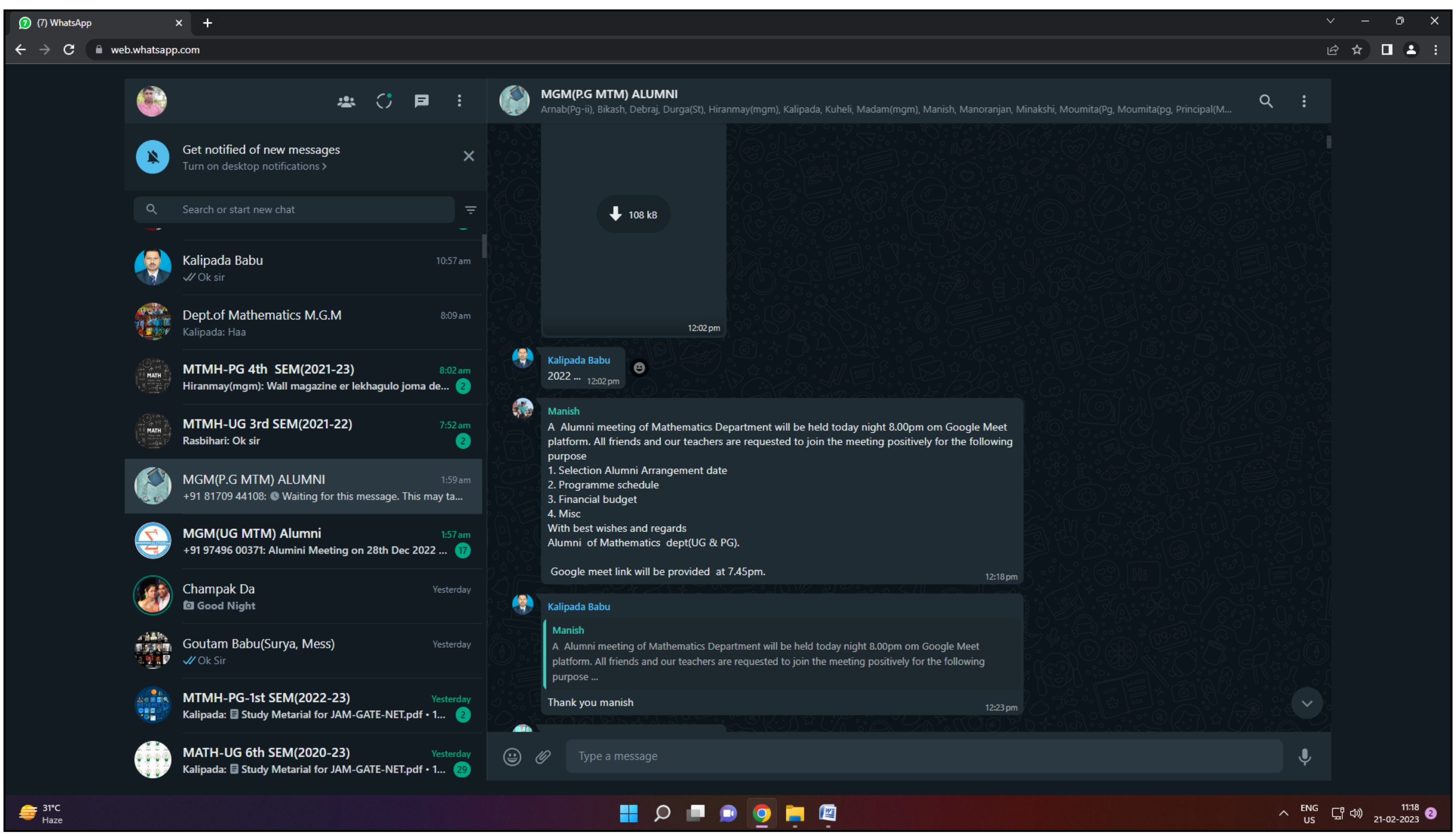
MGM(P.G MTM) ALUMNI
Arnab(Pg-ii), Bikash, Debraj, Durga(St), Hiranmay(mgm), Kalipada, Kuheli, Madam(mgm), Manish, Manoranjan, Minakshi, Moumita(Pg, Moumita(pg, Principal(M...
146 kB
Sk Towkir Alam Msc 2020-2022.
B.Ed- 2022-2024 9:00 am
Kalipada Babu
Forwarded
https://www.iirs.gov.in/iirs/sites/default/files/pdf/2023/113rd_Course_Brochure.pdf 10:23 pm
Forwarded
Please see this advertisement, I think it is helpful for the students. They also get the certificate from isro.
There is two type of registration, one is individual and other is through the institute. 10:24 pm
Kalipada Babu
Faculty/Teacher Recruitment I salary 15 lakh I At Aakash institute I Allen institute
We will provide you proper guidance for being a
youtube.com
https://youtu.be/6NUmAhvOpms 11:19 pm
07/01/2023
Type a message
31°C Haze
ENG US 11:17 21-02-2023


MGM(P.G MTM) ALUMNI
Arnab(Pg-ii), Bikash, Debraj, Durga(St), Hiranmay(mgm), Kalipada, Kuheli, Madam(mgm), Manish, Manoranjan, Minakshi, Moumita(Pg, Moumita(pg, Principal(M...
https://youtu.be/lFrpFOmEBcl 8:03 pm
24/12/2022
Kalipada Babu
history of Trigonometry। ত্রিকোণমিতির ইতিহাস
এই পর্বে আমরা ত্রিকোণমিতির সংক্ষিপ্ত ইতিহাস
youtube.com
https://youtu.be/eLoG42a35F8 8:07 pm
25/12/2022
Kalipada Babu
আজ জাতীয় গণিত দিবস। এই দিবসটি উদযাপনের পেছনের মূল উদ্দেশ্য মানবতার বিকাশের জন্য গণিতের গুরুত্ব সম্পর্কে মানুষের মধ্যে সচেতনতা বৃদ্ধি করা। দেশের তরুণ প্রজন্মের মধ্যে গণিত শেখার প্রতি ইতিবাচক দৃষ্টিভঙ্গি অনুপ্রেরণা ও বিকাশের জন্য বেশ কয়েকটি উদ্যোগ নেওয়া হয়। প্রতি বছর ২২ ডিসেম্বর, গণিত দিবসটি ভারতের মহান গণিতবিদ রামানুজনের জন্মদিনে পালিত হয়। রামানুজন গণিতের ক্ষেত্রে তাঁর মূল্যবান অবদান রেখেছেন। যদিও আর্যভট্ট, ব্রহ্মগুপ্ত, মহাবীর, দ্বিতীয় ভাস্করের মতো বড় বড় ব্যক্তিত্বও অতীতে এই ক্ষেত্রে গুরুত্বপূর্ণ ভূমিকা পালন করেছিল, তবে রামানুজন খুব অল্প বয়সেই একটি স্পষ্ট প্রতিভার লক্ষণ দেখিয়েছিলেন, এবং ভগ্নাংশ, অসীম সিরিজ, সংখ্যা তত্ব, গাণিতিক বিশ্লেষণ ইত্যাদি সম্পর্কে তাঁর অবদান গণিতের একটি উদাহরণ স্থাপন করেছে। ২০১২ সালে রামানুজনের ১২৫ তম জন্মদিন থেকেই এই দিনটিকে ...Read more 9:35 pm
26/12/2022
Kalipada Babu
https://kgpbangla.in/latest-news/schools-want-the-best-teachers-training-will-be-given-by-iit-kharagpur-convocation-announcement-director/10095/ 2:25 pm
Type a message


MGM(P.G MTM) ALUMNI
Arnab(Pg-ii), Bikash, Debraj, Durga(St), Hiranmay(mgm), Kalipada, Kuheli, Madam(mgm), Manish, Manoranjan, Minakshi, Moumita(Pg, Moumita(pg, Principal(M...
108 kB
12:02 pm
Kalipada Babu
2022 ... 12:02 pm
Manish
A Alumni meeting of Mathematics Department will be held today night 8.00pm om Google Meet platform. All friends and our teachers are requested to join the meeting positively for the following purpose
1. Selection Alumni Arrangement date
2. Programme schedule
3. Financial budget
4. Misc
With best wishes and regards
Alumni of Mathematics dept(UG & PG).
Google meet link will be provided at 7.45pm. 12:18 pm
Kalipada Babu
Manish
A Alumni meeting of Mathematics Department will be held today night 8.00pm om Google Meet platform. All friends and our teachers are requested to join the meeting positively for the following purpose ...
Thank you manish 12:23 pm
Type a message

Book List Details

Central Library

Mugberia Gangadhar Mahavidyalaya

The Department of Mathematics arranged various types of workshop and ICT based class for GATE/ NET/JAM/Competitive Examination during every academic year. In the departmental routine, the teachers take the classess as per routine. Most of students are much more interest about the library and many student are qualifyed in NET/GATE/JAM/CAT/CTET/TET and others examinations. Several books for many competitive exam listed below: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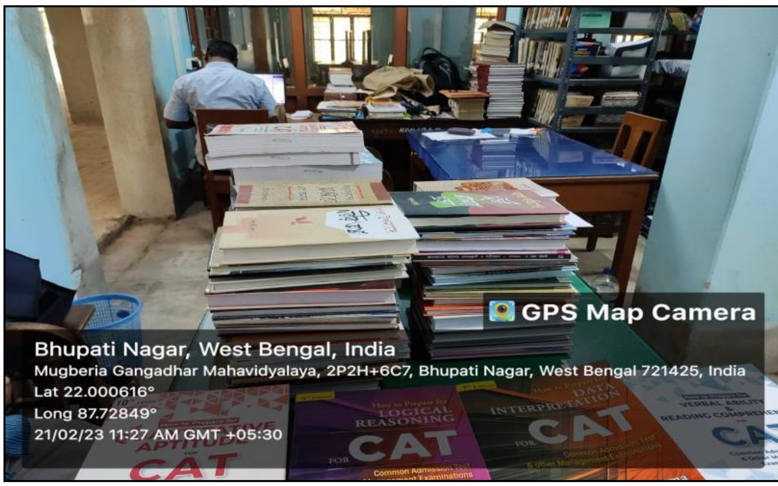
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+6C7, Bhupati Nagar, West Bengal 721425, India
Lat 22.000616°
Long 87.72849°
21/02/23 11:27 AM GMT +05:30
MATLAB
Programming


GPS Map Camera
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+6C7, Bhupati Nagar, West Bengal 721425, India
Lat 22.000616°
Long 87.72849°
21/02/23 11:27 AM GMT +05:30
MATLAB
Programming


GPS Map Camera
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+6C7, Bhupati Nagar, West Bengal 721425, India
Lat 22.000616°
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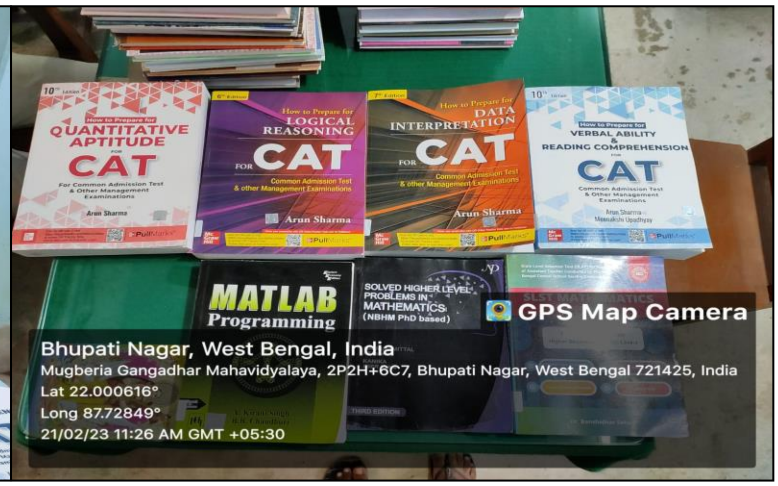
21/02/23 11:27 AM GMT +05:30
LOGICAL REASONING
CAT


QUANTITATIVE APTITUDE
CAT
LOGICAL REASONING
CAT
DATA INTERPRETATION
CAT
VERBAL ABILITY & READING COMPREHENSION
CAT
MATLAB
Programming
SOLVED HIGHER LEVEL PROBLEMS IN MATHEMATICS
(NBHM PhD based)
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Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+6C7, Bhupati Nagar, West Bengal 721425, India
Lat 22.000616°
Long 87.72849°
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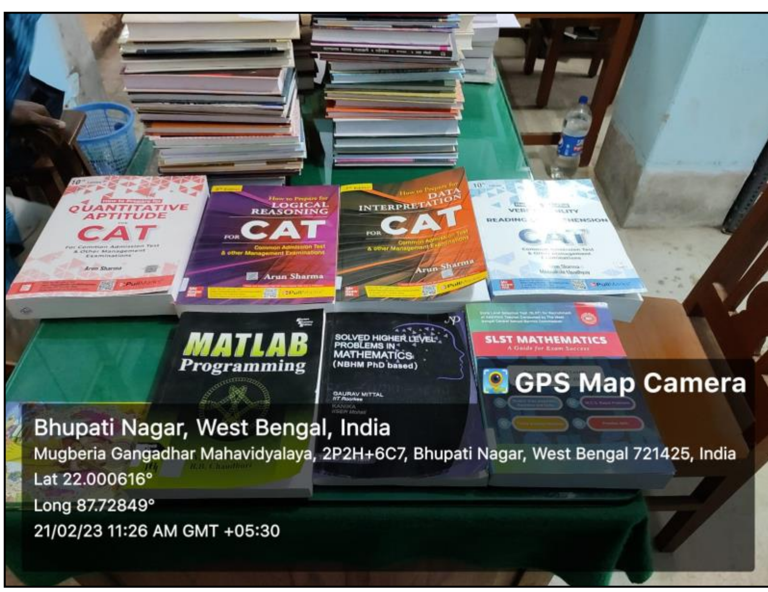
QUANTITATIVE APTITUDE
CAT
LOGICAL REASONING
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DATA INTERPRETATION
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SOLVED HIGHER LEVEL PROBLEMS IN MATHEMATICS
(NBHM PhD based)
SLST MATHEMATICS
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QUANTITATIVE APTITUDE
CAT
LOGICAL REASONING
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DATA INTERPRETATION
CAT
VERBAL ABILITY & READING COMPREHENSION
CAT
MATLAB
SOLVED HIGHER LEVEL PROBLEMS IN MATHEMATICS
GPS Map Camera
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+6C7, Bhupati Nagar, West Bengal 721425, India
Lat 22.000616°
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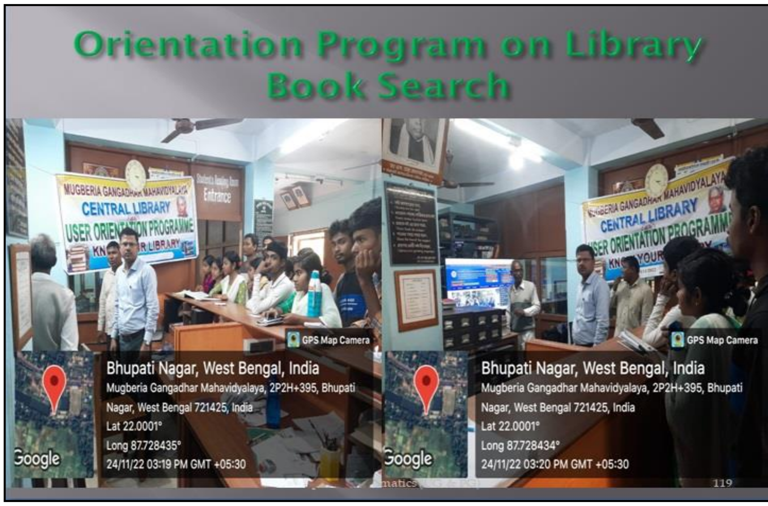
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USER ORIENTATION PROGRAMME
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Lat 22.0001°
Long 87.728435°
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Google
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+395, Bhupati Nagar, West Bengal 721425, India
Lat 22.0001°
Long 87.728434°
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119


GPS Map Camera
Bhupati Nagar, West Bengal, India
2P2H+395, Bhupati Nagar, West Bengal 721425, India
Lat 22.000045°
Long 87.728413°
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Google
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+395, Bhupati Nagar, West Bengal 721425, India
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Long 87.728433°
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120


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Mugberia Gangadhar Mahavidyalaya, 2P2H+395, Bhupati Nagar, West Bengal 721425, India
Lat 22.000103°
Long 87.72843°
29/11/22 01:48 PM GMT +05:30
Bhupati Nagar, West Bengal, India
Mugberia Gangadhar Mahavidyalaya, 2P2H+395, Bhupati Nagar, West Bengal 721425, India
Lat 22.000103°
Long 87.72843°
29/11/22 01:47 PM GMT +05:30
121


Orientation Program on Library Book Search
MUGBERIA GANGADHAR MAHAVIDYALAYA
CENTRAL LIBRARY
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Study Material for JAM/GATE/NET/NBHM Examinations

By

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Contents

Chapter 1

Ordinary Differential Equations

1.1 Worked Out Example

Example 1.1 Determine the order and degree of the following ODEs.

(i) $\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{\frac{3}{2}} = \rho\frac{d^2y}{dx^2}$ N.B.U(Hons)-08 (ii) $\left(\frac{d^2y}{dx^2}\right)^2 + y = \frac{dy}{dx}$ N.B.U(Hons)-07

(iii) $(x+y)^2\frac{dy}{dx} + 5y = 3x^4$ (iv) $\frac{dy}{dx} + \sin(\frac{dy}{dx}) = 0$ (v) $\frac{d^2y}{dx^2} + \cos x\frac{dy}{dx} + \sin y = 0$

(vi) $\left\{\frac{d^3y}{dx^3}\right\}^{\frac{3}{2}} + \left\{\frac{d^3y}{dx^3}\right\}^{\frac{2}{3}} = 0$ (vii) $\left(\frac{d^2y}{dx^2}\right)^{-\frac{7}{2}}\frac{dy}{dx} + y\left(\frac{d^2y}{dx^2}\right)^{-\frac{5}{2}} = 0$

Solution. (i) Here, $\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{\frac{3}{2}} = \rho\frac{d^2y}{dx^2}$ or $\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^3 = \rho^2\left(\frac{d^2y}{dx^2}\right)^2$.
So the order and degree of the equation are two, since the highest order derivative is two and the exponent of the highest order derivative is also two.
(ii) The order and degree of ODE are two.
(iii) The order and degree of ODE are one.
(iv) The degree of $\frac{dy}{dx} + \sin(\frac{dy}{dx}) = 0$ is not defined as the differential equation is not a polynomial equation in its derivatives although it has order 1.
(v) The order is 2 and the degree of $\frac{d^2y}{dx^2} + \cos x\frac{dy}{dx} + \sin y = 0$ is 1 as the differential equation is a polynomial equation in its derivatives although not a polynomial in y.
(vi) The order of $\left\{\frac{d^3y}{dx^3}\right\}^{\frac{3}{2}} + \left\{\frac{d^3y}{dx^3}\right\}^{\frac{2}{3}} = 0$ is 3. The L.C.M of the denominators of $\frac{3}{2}, \frac{2}{3}$ is 6. To find the degree, the said differential equation can be written as $\left\{\left(\frac{d^2y}{dx^2}\right)^{\frac{3}{2}}\right\}^6 = \left\{-\left(\frac{d^2y}{dx^2}\right)^{\frac{2}{3}}\right\}^6$ i.e., $\left(\frac{d^2y}{dx^2}\right)^9 = \left(\frac{d^2y}{dx^2}\right)^4$.
Hence the degree of the given differential equation is 9.

Remark: It may be mention here that the differential equation $\left(\frac{d^2y}{dx^2}\right)^4 = \left(\frac{d^2y}{dx^2}\right)^9$ can not be consider as $\left(\frac{d^2y}{dx^2}\right)^5 = 1$.

(vii) The order of $\left(\frac{d^2y}{dx^2}\right)^{-\frac{7}{2}}\frac{dy}{dx} + y\left(\frac{d^2y}{dx^2}\right)^{-\frac{5}{2}} = 0$ is 2. The power of highest order derivative is negative. But the degree of a differential equation is always positive. So to find the degree, we are multiplying $\left(\frac{d^2y}{dx^2}\right)^{\frac{7}{2}}$ in both side of the said differential equation and then we obtain

$\frac{dy}{dx} + y\frac{d^2y}{dx^2} = 0$. Hence the degree of the given differential equation is 1.

Example 1.2 Find the differential equation from the relation $y = ax^2 + a^2$ where a is an arbitrary constant.

Solution: The relation is given by

$$y = ax^2 + a^2 \tag{1.1}$$

The relation (1.1) contain only one arbitrary constant i.e. a, so order of the differential equation is of first order.
Differentiating (1.1) with respect to x, we get

$$\frac{dy}{dx} = 2xa \qquad \Rightarrow a = \frac{1}{2x}\frac{dy}{dx}$$

Substituting the value of a in (1.1), we get

$$y = \frac{1}{2x}\frac{dy}{dx}x^2 + \left(\frac{1}{2x}\frac{dy}{dx}\right)^2 \Rightarrow \left(\frac{dy}{dx}\right)^2 + 2x^3\frac{dy}{dx} - 4x^2y = 0.$$

Which is the required differential equation.

Example 1.3 Determine the order and degree of the following differential equation
(i)$(\frac{dy}{dx})^2 + 3y^2 = 0$ (ii) $\left(\frac{d^2y}{dx^2}\right)^2 + xy = \frac{dy}{dx}$ (iii) $\sqrt{\frac{dy}{dx}} = 2y$.
(iv) $\left(\frac{dy}{dx}\right)^{\frac{2}{3}} = 3 + \frac{d^2y}{dx^2}$ (v)$\left(\frac{d^2y}{dx^2} + 1\right)^{\frac{3}{2}} = 3x\frac{dy}{dx}$ (vi) $y + \frac{dy}{dx} = e^{\frac{d^2y}{dx^2}}$

Solution: (i) Order is 1 and degree is 2.
(ii) Order is 2 and degree is 2.
(iii) $\sqrt{\frac{dy}{dx}} = 2y \Rightarrow \frac{dy}{dx} = 4y^2$, order is 1 and degree is 1.
(iv) $\left(\frac{dy}{dx}\right)^{\frac{2}{3}} = 3 + \frac{d^2y}{dx^2} \Rightarrow \left(\frac{dy}{dx}\right)^2 = \left(3 + \frac{d^2y}{dx^2}\right)^3$.
Hence the order is 2 and degree is 3.
(v) $\left(\frac{d^2y}{dx^2} + 1\right)^{\frac{3}{2}} = 3x\frac{dy}{dx} \Rightarrow \left(\frac{d^2y}{dx^2} + 1\right)^3 = 9x^2\left(\frac{dy}{dx}\right)^2$.
Hence the order is 2 and degree is 3.
(vi) The differential equation can be written as $\frac{d^2y}{dx^2} = \log(y + \frac{dy}{dx})$, so the degree of the said differential equation can not be defined as it is not a polynomial of derivatives although it has order 2.

1.2 Multiple Choice Questions(MCQ)

1. The type of the following differential equation $y'' + \sin(x + y) = \sin x$ is
   (a) linear, homogeneous (b) nonlinear, homogeneous **Gate(MA): 2001**

(c) linear, nonhomogeneous (d) nonlinear, nonhomogeneous
Ans. (d) is correct.

2. If $y = \ln(\sin(x+a)) + b$ where a and b are constants, is the primitive, then the corresponding lowest order differential equation is
(a) $y'' = -(1 + (y')^2)$ (b) $y'' = 1 + (y')^2$
(c) $y'' = -(2 + (y')^2)$ (d) $y'' = -(3 + (y')^2)$ [JAM CA-2005]
Ans. (a)
Hint. $y = \ln(\sin(x + a)) + b$ contains two arbitrary constants. Eliminating a and b, we get, $y'' = -(1 + (y')^2)$.

3. The differential equation representing all circles centrad at $(1, 0)$ is
(a) $x + y\frac{dy}{dx} = 1$ (b) $x - y\frac{dy}{dx} = 1$ (c) $y - x\frac{dy}{dx} = 1$ (d) $y + x\frac{dy}{dx} = 1$
Ans. (a) [JAM CA-2010]

4. The differential equation representing the family of circles touching y- axis at the origin is
(a) Non linear and of first order (b) linear and of second order
(c) exact and linear but not homogeneous (d) exact, homogeneous and linear [JAM MA-2006;]
Ans. (a)

5. The differential equation $(3y - 2x)\frac{dy}{dx} = 2y$ JAM CA-2006
(a) homogeneous but not linear (b) linear and homogeneous
(c) linear but not homogeneous (d) homogeneous and linear
Ans. (a)

6. The degree of $\frac{d^2y}{dx^2} = \log(y + \frac{dy}{dx})$ is
(a) 1 (b) 0 (c) Does not exist (d) 2
Ans. (c)
Hint. The R.H.S of the given differential equation can not be a polynomial of $\frac{dy}{dx}$.

7. The order and degree of $\left(\frac{d^2y}{dx^2}\right)^{\frac{1}{3}} = \left(y + \frac{dy}{dx}\right)^{\frac{1}{2}}$ are
(a) 1, 3 (b) 2, 1 (c) 2, Does not exist (d) 2, 2
Ans. (d)

8. The order and degree of $\frac{d^2}{dx^2}\left(\frac{d^2y}{dx^2}\right)^{-\frac{3}{2}} = 0$ are
(a) 1, 3 (b) 4, 1 (c) 2, Does not exist (d) 3, 2 [IAS(Prel.) -2006;]
Ans. (b)
Hint. The problem is same with (*vii*) of Example 1.1.

9. For the IVP $y' = f(x, y), y(0) = 0$ which is true **Gate(MA): 2003**
(a) $f(x, y) = \sqrt{xy}$ satisfies Lipschitz condition and so IVP has unique solution.
(b)$f(x, y) = \sqrt{xy}$ does not satisfies Lipschitz condition and so IVP has no solution.
(c)$f(x, y) = ||y||$ satisfies Lipschitz condition and so IVP has unique solution.
(d)$f(x, y) = ||y||$ does not satisfies Lipschitz condition and so IVP has unique solution.
Ans. (c) is correct.

Hint. Since $||f(x, y_1) - f(x, y_2)|| = \Big|\big|||y_1|| - ||y_2||\big|\Big|$. Then, $\frac{||f(x,y_1)-f(x,y_2)||}{||y_1-y_2||} = \frac{\Big|\big|||y_1||-||y_2||\big|\Big|}{||y_1-y_2||} = 1$. So $\frac{\partial f}{\partial y} = 1$ which is continuous and bounded at any point in $\Re$. Hence, $f(x, y) = ||y||$ satisfies Lipschitz condition and so IVP has unique solution.

10. Consider the initial value problem $\frac{dy}{dx} = 60(y^2)^{\frac{1}{5}}$, $x > 0$, $y(0) = 0$ has
(a) a unique solution (b) two solutions (c) no solution (d) infinite number of solutions **NET(MS): (Dec.)2012**
Ans. (b).
Hint. $\frac{\partial f(x,y)}{\partial y} = 24y^{\frac{-3}{5}} \to \infty$ as $y \to 0$. So the solution is not unique. Also $y = 0$ and $y = (36x)^{\frac{5}{3}}$ are two solutions of the given differential equations. Hence (b) is correct.

11. For nbd $n = 2$, the differential equation $y' = \frac{y}{\sqrt{x}}$, $y(2) = 4$ has
(a)no solution (b)a unique solution
(c)exactly two solution (d)infinitely many solution. **Gate(MA): 2005**
Ans. (b) is correct.
Hint. Here $f(x, y) = \frac{y}{\sqrt{x}}$ and $\frac{\partial f(x)}{\partial y} = \frac{1}{\sqrt{x}}$. Then f is continuous in the neighborhood of 2. Also $\frac{\partial f}{\partial y}$ is continuous and bounded in the same neighborhood of 2. Hence the existence and uniqueness theorem state that y has unique solution.

12. The initial value problem $x\frac{dy}{dx} = y + x^2$, $x > 0$, $y(0) = 0$ has **GATE(MA)-11**
A) infinitely many solutions B) a unique solution
C) exactly two solutions D) no solution.
Ans. A)

13. The initial value problem

$$x\frac{dy}{dx} = \sqrt{y},\ y > 0,\ y(0) = \alpha,\ \alpha \geq 0 \text{ has} \qquad \textbf{JAM} - \textbf{2015}$$

A) at least two solutions if $\alpha = 0$ B) no solution if $\alpha > 0$
C) at least one solutions if $\alpha > 0$ D) a unique solution if $\alpha = 0$
Ans. (A) and (C).

14. Consider the initial value problem $\frac{dy}{dx} = xy^3$, $y(0) = 0$, $(x, y) \in \Re \times \Re$. Then which of the following are correct? **NET(MS): (June)2013**
(a) The function $f = xy^3$ does not satisfy a Lipschitz condition *w.r.t* y in the nbd of $y = 0$
(b) There exists a unique solution for the IVP
(c)There exists no solution for the IVP
(d) There exists more than one solution for the IVP
Ans. (b).

15. Consider the initial value problem $\frac{dy}{dx} = f(t)y(t)$, $y(0) = 1$ where $f : \Re \to \Re$ is continuous. Then this initial value problem has **NET(MS): (June)2012**
(a) infinite many solutions for some f (b)a unique solution in R
(c) no solution in $\Re$ for some f (d) a solution in an interval containing 0, but not on $\Re$ for some f.
Ans. (b).

16. Consider the initial value problem $\frac{dy}{dx} = (1+f^2(t))y(t)$, $y(0) = 1 : t \geq 0$ where f is a bounded continuous function on $[0, \infty)$. Then **NET(MS): (Dec.)2011**
(a) this equation admits a unique solution $y(t)$ and further $\lim_{t\to\infty} y(t)$ exists and is finite
(b) this equation admits two linearly independent solutions
(c) this equation admits a bounded solution for which $\lim_{t\to\infty} y(t)$ does not exist

(d) this equation admits a unique solution $y(t)$ and further $\lim_{t\to\infty} y(t) = \infty$

Ans. (d).

17. Let $y_1(x)$ and $y_2(x)$ be the solutions of the differential equation $\frac{dy}{dx} = y + 17$ with initial conditions $y_1(0) = 0,\ y_2(0) = 1$ **NET(MS): (Dec.)2012**
(a) y_1 and y_2 will never intersect (b) y_1 and y_2 will never intersect at $x = 17$
(c) y_1 and y_2 will never intersect at $x = e$ (d) y_1 and y_2 will never intersect at $x = 1$
Ans. (a).

18. Consider the differential equation $\sin 2x\frac{dy}{dx} = 2y + 2\cos x,\ y(\frac{\pi}{4}) = 1 - \sqrt{2}$. Then which of the following statement(s) is (are) TRUE ? **JAM(MA):2016**
(A) The solution is unbounded when $x \to 0$ (B) The solution is unbounded when $x \to \frac{\pi}{2}$
(C) The solution is bounded when $x \to 0$ (D) The solution is bounded when $x \to \frac{\pi}{2}$
Ans. (C) and (D).

19. The solution of the initial value problem $\frac{dy}{dx} = y^2,\ y(0) = -1,\ (x, y) \in \Re \times \Re$ on
(a) $(-\infty, \infty)$ (b) $(-\infty, -1)$ (c) $(-2, 2)$ (d) $(-1, \infty)$ **NET(MS): (June)2013**
Ans. (b)
Hint. Like the example **??** / example **??**.

20. If the integrating factor of $(x^7y^2 + 3y)dx + (3x^8y - x)dy = 0$ is $x^m y^n$,then
(a)$n = -7, m = 1$ (b)$m = -7, n = 1$ (c)$n = m = 1$ (d)$n = m = 0$ **Gate(MA): 2002**
Ans. (b) is correct.
Hint. The given equation can be written as $x^7y(ydx + 3xdy) + (3ydx - xdy) = 0$. If $x^m y^n$ be I.F. then ,$7 + m + 1 = \frac{1+n+1}{3}$ and $\frac{m+1}{3}\frac{n+1}{-1}$ or $3m - n = -22$ and $m + 3n = 4$. Solving we get $m = -7, n = 1$

21. The initial value problem
$(x^2 - x)y' = (2x - 1)y, y(x_0) = y_0$ has a unique solution if $(x_0, y_0) =$
(a)$(2, 1)$ (b)$(1, 1)$ (c)$(0, 0)$ (d)$(0, 1)$ **Gate(MA): 2002**
Ans. (a) is correct.

22. The general solution of the differential equation $y' + \tan y \tan x = \cos x \sec y$ is
(a)$2\sin y = (x + c - \sin x \cos x)\sec x$ (b)$\sin y = (x + c)\cos x$
(c)$\cos y = (x + c)\sin x$ (d)$\sec y = (x + c)\cos x$ **Gate(MA): 2001**
Ans. (b) is correct.
Hint. Given $y' + \tan y \tan x = \cos x \sec y$. Then

$$\cos y\frac{dy}{dx} + \sin y \tan x = \cos x \tag{1.2}$$

Let $\sin y = z$ or, $\cos y\frac{dy}{dx} = \frac{dz}{dx}$. Then (1.2) becomes $\frac{dz}{dx} + z\tan x = \cos x \Rightarrow (ze^{\int \tan xdx}) = \int(\cos xe^{\int \tan xdx})dx + c \Rightarrow ze^{\log \|\sec x\|} = \int \frac{\cos x}{\cos x}dx + c \Rightarrow \frac{z}{\cos x} = (c + x) \Rightarrow z = (c + x)\cos x \Rightarrow \sin y = (c + x)\cos x$.

23. The differential equation $\frac{dy}{dx} = k(a - y)(b - y)$ solved with the condition $y(0) = 0$, then the result is
(a)$\frac{b(a-y)}{a(b-y)} = e^{(a-b)kx}$ (b)$\frac{b(a-x)}{a(b-x)} = e^{(a-b)ky}$ (c)$\frac{a(b-y)}{b(a-y)} = e^{(a-b)kx}$ (d)$xy = cx$ **Gate(MA): 2000**
Ans. (a) is correct.
Hint. $\frac{dy}{dx} = k(a - y)(b - y)$ or $\int \frac{dy}{(a-y)(b-y)} = \int kdx \Rightarrow \frac{1}{(b-a0}\int(\frac{1}{a-y} - \frac{1}{b-y})dy = \int kdx \Rightarrow$

$-\log(a-y)+\log(b-y)=kx(b-a)+c$. Here $y(0)=0$, we get $c=\log(\frac{b}{a})$, we get, $\log(\frac{b-y}{a-y})=kx(b-a)+\log(\frac{b}{a}) \Rightarrow \log(\frac{a(b-y)}{b(a-y)})=kx(b-a) \Rightarrow \frac{a(b-y)}{b(a-y)}=e^{kx(b-a)}$.

24. If $y(x)$ satisfies the initial value $(x^2+y)dx=xdy,\ y(1)=2$, then $y(2)$ is equal to
(a) 4 (b) 5 (c) 6 (d) 8 **GATE(MA): 2015**
Ans. (c).

25. One of the points which lies on the solution curve of the differential equation $(y-x)dx+(x+y)dy=0$, with the given condition $y(0)=1$, is
(a)$(1,-2)$ (b)$(2,-1)$ (c)$(2,1)$ (d)$(-1,2)$ JAM(MA)-2016
Ans. (c)

26. The solution of the initial value problem $xy'-y=0$ with $y(1)=1$ is
(a) $y(x)=x$ (b)$y(x)=\frac{1}{x}$ (c) $y(x)=2x-1$ (d) $y(x)=\frac{1}{2x-1}$ [JAM CA-2007]
Ans. (a)

27. The solution of the differential equation $\frac{dy}{dx}=-\frac{x(x^2+y^2-10)}{y(x^2+y^2+5)}$,$y(0)=1$ is JAM(MS)-2008
(a) $x^4-2x^2y^2-y^4-20x^2-10y^2+11=0$ (b) $x^4+2x^2y^2+y^4+20x^2+10y^2-11=0$
(c) $x^4+2x^2y^2-y^4+20x^2-10y^2+11=0$ (d) $x^4+2x^2y^2+y^4-20x^2+10y^2-11=0$
Ans. (d)

28. The solution of the differential equation $\frac{dy}{dx}=\frac{y^2\cos x+\cos y}{x\sin y-2y\sin x}$,$y(\frac{\pi}{2})=0$ is
(a) $y^2\cos x+x\sin y=0$ (b) $y^2\sin x+x\cos y=\frac{\pi}{2}$
(c) $y^2\sin x+x\sin y=0$ (d) $y^2\cos x+x\cos y=\frac{\pi}{2}$ JAM(MS)-2009
Ans. (b)

29. Consider the differential equation $\frac{dy}{dx}=ay-by^3$, where $a,b>0$ and $y(0)=y_0$ As $x\to\infty$, the solution $y(x)$ tends to
(a) 0 (b) $\frac{a}{b}$ (c) $\frac{b}{a}$ (d) y_0 JAM(MA)-2009
Ans. (b)

30. Consider the differential equation $\cos(y^2)dx-2xy\sin(y^2)dy=0$
(a) e^x is an integrating factor. (b) e^{-x} is an integrating factor.
(c) x is an integrating factor. (d) x^3 is an integrating factor. JAM MA-2009
Ans. (c)

31. One of the integrating factors of the differential equation $(y^2-3xy)dx+(x^2-xy)dy=0$ is
(a) $\frac{1}{x^2y^2}$ (b) $\frac{1}{x^2y}$ (c) $\frac{1}{x^3y^2}$ (d) $\frac{1}{xy}$ JAM MA-2007
Ans. (b)

32. Consider the differential equation $(x+y+1)dx+(2x+2y+1)dy=0$. Which of the following statements is true?
(a)The differential equation is linear (b)The differential equation is exact (c)e^{x+y} is an integrating factor of the differential equation (d)A suitable substitution transforms the differentiable equation to the variables separable form. JAM MA-2010
Ans. (d)

33. For the differential equation $f(x,y)\frac{dy}{dx}+g(x,y)=0$ to be exact if
(a)$\frac{\partial f}{\partial y}=\frac{\partial g}{\partial x}$ (b) $\frac{\partial f}{\partial x}=\frac{\partial g}{\partial y}$ (c)$\frac{\partial^2 f}{\partial x^2}=\frac{\partial^2 g}{\partial y^2}$ (d) none of these
Ans. (b)

34. If y^a is an integrating factor of the differential equation $2xydx-(3x^2-y^2)dy=0$, then the value of a is

(a)-4 (b)4 (c)-1 (d)1 JAM MA-2011
Ans. (a)

35. The nonzero value of n for which the differential equation $(3xy^2+n^2x^2y)dx+(nx^3+3x^2y)dy = 0$, $x \neq 0$, be exact is
(a)-3 (b)-2 (c)2 (d)3 JAM(MA)-2016
Ans. (d)

36. The differential equation $2ydx-(3y-2x)dy = 0$ JAM CA-2006
(a) exact and homogeneous but not linear (b) linear and homogeneous but not exact
(c) exact and linear but not homogeneous (d) exact, homogeneous and linear
Ans. (a)

37. The general solution of the differential equation $(x+y-3)dx-(2x+2y+1)dy = 0$ is
(a) $ln|3x+3y-2|+3x+6y = k$ (b)$ln|3x+3y-2|+3x-6y = k$
(c) $7\,ln|3x+3y-2|+3x+6y = k$ (d) $ln|3x+3y-2|-3x+6y = k$ [JAM CA-2006]
Ans. (c)

38. The general solution of the differential equation $(6x^2-e^{-y^2})dx+2xye^{-y^2}dy = 0$ is
(a) $x^2(2x-e^{-y^2}) = c$ (b)$x^2(2x+e^{-y^2}) = c$
(c) $x(2x+e^{-y^2}) = c$ (d) $x(2x^2-e^{-y^2}) = c$ JAM CA-2006
Ans. (d)

39. General solution of the differential equation $xdy = (y+x\,e^{-\frac{y}{x}})dx$ is given by
(a) $e^{-\frac{y}{x}} = ln\,x+c,\ x>0$ (b) $e^{\frac{y}{x}} = ln\,x+c,\ x>0$ (c) $e^{-\frac{y}{x}}+ln\,x = c,\ x>0$ (d) $e^{-\frac{y}{x}} = x+c$
Ans. (b) JAM CA-2005

40. Solution of the differential equation $xy'+\sin 2y = x^3\sin^2 y$ is JAM CA-2005
(a) $\cot y = -x^3+c\,x^2$ (b) $2\cot y = -x^3+3c\,x^2$ (c) $\tan y = -x^3+c\,x^2$ (d) $2\tan y = -x^4+2c\,x^2$
Ans. (a)

41. The differential equation $(2x^2+by^2)dx+cxydy = 0$ is made exact by multiplying the integrating factor $\frac{1}{x^2}$. Then the relation between b and c is
(a) $2c = b$ (b)$b = c$ (c)$2b+c = 0$ (d)$b+2c = 0$ JAM CA-2008
Ans. (c)

42. The solution of the differential equation $yy'+y^2-x = 0$ where c is a constant, is
(a) $y^2 = x+c\,e^{-2x}$ (b)$y^2 = x+c\,e^{-2x}-1$
(c) $y^2 = x+c\,e^{-2x}-\frac{1}{2}$ (d) $y^2 = x+c\,e^{-2x}+\frac{1}{2}$ JAM(CA)-2008
Ans. (c)

43. If $e^x+xy+x\sin y+e^y = c$ is the general solution of an exact differential equation, then the differential equation is JAM CA-2009
(a)$\frac{dy}{dx} = \frac{e^x-y-\sin y}{e^y-x-x\cos y}$ (b)$\frac{dy}{dx} = \frac{e^x+y+\sin y}{e^y+x+x\cos y}$
(c)$\frac{dy}{dx} = \frac{-(e^x+y+\sin y)}{e^y+x+x\cos y}$ (d)$\frac{dy}{dx} = \frac{-(e^x-y-\sin y)}{e^y-x-x\cos y}$
Ans. (c)

44. The general solution of the differential equation $y'(x+y^2) = y$ is JAM CA-2009
(a)$x = cy+y^2$ (b)$x = cy-y^2$ (c)$y = cx+x^2$ (d)$y = cx-x^2$
Ans. (a)

45. If $y(x)$ is the solution of the differential equation $\frac{dy}{dx} = 2(1+y)\sqrt{y},\ y>0,\ y(0) = 0,\ y(\frac{\pi}{2}) = 1$, then the largest interval on which the solution exists is, **GATE(MA)-06**

A) $[0, \frac{3\pi}{4})$ B) $[0, \pi)$ C) $[0, 2\pi)$ D) $[0, \frac{2\pi}{3})$
Ans. (C)

46. Consider the differential equation $\frac{dy}{dx} - 2x = \phi(x),\ x \in \Re$, satisfying $y(0) = 0$,

$$\text{where } \phi(x) = \begin{array}{ll} 0 & ,\ x \le 0 \\ = 1, & x > 0 \end{array}$$

This initial value problem
(a) has a continuous solution which is not differentiable at $x = 0$ (b)has a continuous solution which is differentiable at $x = 0$ (c) has a continuous solution which is differentiable on at $\Re$ (d) does not have a continuous solution $\Re$ [JAM GP-2008]
Ans. (a)

47. The equation

$$(\alpha xy^3 + y\cos x)dx + (x^2y^2 + \beta \sin x)dy = 0 \text{ is exact for} \qquad \textbf{GATE(MA)} - \textbf{09}$$

A) $\alpha = \frac{3}{2}, \beta = 1,$ B) $\alpha = 1, \beta = \frac{3}{2},$ C) $\alpha = \frac{2}{3}, \beta = 1$ D) $\alpha = 1, \beta = \frac{2}{3}$
Ans. (C)

48. Consider the differential equation $y' - y = -y^2$. Then $\lim_{x\to\infty} y(t)$ is equal to
(a) 1 (b) 0 (c) -1 (d) ∞ JAM CA-2010
Ans. (a)

49. If k is a constant such that $xy + k = e^{\frac{(x-1)^2}{2}}$ satisfies the differential equation $x\frac{dy}{dx} = (x^2 - x - 1)y + (x - 1)$, then k is equal to
(a) 1 (b) -1 (c) 3 (d) -2 JAM(MA)-2007
Ans. (a)

50. An integrating factor of $x\frac{dy}{dx} + (3x + 1)y = xe^{-2x}$ is
(a)xe^{-4x} (b)xe^{3x}
(c)$3xe^{3x}$ (d)$3xe^{-3x}$ JAM(MA)-2005
Ans. (b)

51. The initial value problem corresponding to the integral equation $y(x) = 1 + \oint_0^x y(t)dt$ is
(a)$y' - y = 0, y(0) = 1$ (b)$y' + y = 0, y(0) = 0$ (c)$y' - y = 0, y(0) = 0$ (d)$y' + y = 0, y(0) = 1$ **Gate(MA): 2001**
Ans. (a) is correct.
Hint. Since $y'(x) = y(x)$ or, $y' - y = 0$ and for given equation $y(0) = 1$

52. If $y(t) = 1 + \int_0^t y(v)e^{-(t+v)}dv$ then $y(t)$ at $t = 0$
(a) 0 (b) 1 (c) 2 (d) 3 **Gate(MA): 2000**
Ans. (b) is correct.

53. If the differential equation $\left(y + \frac{1}{x} + \frac{1}{x^2y}\right)dx + \left(x - \frac{1}{y} + \frac{a}{xy^2}\right)dy = 0$ is exact, then the value of a is
(a)2 (b)1 (c) -1 (d) 0
Ans: (b)

54. The integrating factor of $(2xy - 3y^3)dx + (4x^2 + 6xy^2)dy = 0$ is
(a)$\frac{1}{x^2y}$ (b)x^2y^2 (c) xy^2 (d)xy^3
Ans: (a)

55. Let $u(t)$ be a continuous differentiable function taking nonnegative values for $t > 0$ and satisfying $u'(t) = 4u^{\frac{3}{4}}(t)$; u(0)=0. Then **NET(MS): (Dec.)2015**

$$(a)\ u(t) = 0 \qquad (b)\ u(t) = t^4$$
$$\begin{aligned}(c)\ u(t) &= 0,\ 0 < t < 1\\ &= (t-1)^4,\ t \geq 1\\ (d)\ u(t) &= 0,\ 0 < t < 10\\ &= (t-10)^4,\ t \geq 10.\end{aligned}$$

Ans. (a), (b), (c) and (d).

56. The solution of the initial value problem $\frac{dy}{dx} = \frac{\sin x}{y+2}$, $y(0) = 0$ is
(a) $y(y+2) = 4(1 - \cos x)$ (b) $y(y+4) = 2(1 - \cos x)$
(c) $3y(y+2) = 4(1 - \cos x)$ (d) $y(y+2) = 4(1 - \cos x)$ JAM(GP)-2010
Ans. (b)

57. The integrating factor of the differential equation $\frac{dy}{dx} - 3y = \sin 2x$ is
(a)e^{3x} (b)e^{-3x} (c) e^x (d)none of these
Ans. (b)

58. The integrating factor of the differential equation $\frac{dy}{dx} = \frac{2xy^2+y}{x-2y^3}$ is
(a)$\frac{1}{y}$ (b)$\frac{1}{y^2}$ (c) y (d) y^2 **[JAM-2015]**
Ans: (b)

59. The integrating factor of the differential equation $(2xy + 3x^2y + 6y^3)dx + (x^2 + 6y^2)dy = 0$ is
(a)x^3 (b)y^3 (c) e^{3x} (d) e^{3y} **[JAM-2012]**
Ans. (c)

60. If an integral curve of the differential curve $(y - x)\frac{dy}{dx} = 1$ passing through the curve $(0, 0)$ and $(\alpha, 1)$, then α is equal to
(a)$2 - e^{-1}$ (b)$1 - e^{-1}$ (c) e^{-1} (d) $1 + e$ **[JAM-2015]**
Ans. (c)

61. For $a, b, c \in \Re$, if the differential equation $(ax^2 + bxy + y^2)dx + (2x^2 + cxy + y^2)dy = 0$ be exact then
(a)$b = 2$, $c = 2a$ (b) $b = 4$, $c = 2$ (c)$b = 2$, $c = 4$ (d) $b = 2$, $a = 2c$ **[JAM -2014]**
Ans. (b)

62. The differential equation $(1 + x^2y^3 + \alpha x^2y^2)dx + (2 + x^3y^2 + x^3y)dy = 0$ be exact if α equals
(a)$\frac{1}{2}$ (b) $\frac{3}{2}$ (c) 2 (d) 3 **[JAM -2012]**
Ans. (b)

63. The differential equation $\frac{dy}{dx} + x\sin 2y = x^3\cos^2 y$ can be reduced to linear equation
(a)$\frac{dz}{dx} + x\sin 2y = x^3$ (b)$\frac{dz}{dx} + 2zx = x^3$ (c) $\frac{dz}{dx} - 2zx = x^3$ (d) none of these
Ans. (b)

64. An integrating factor of the differential equation $\frac{dy}{dt} + y = 1$ is
(a)e^t (b)$\frac{e}{t}$ (c) et (d)$\frac{t}{e}$
Ans. (a)

65. The particular solution of the differential equation $y'\sin x = y\log y$ satisfying the initial condition $y(\frac{\pi}{2}) = e$, is

(a)$\log(\tan(\frac{x}{4}))$ (b)$\log(\cot(\frac{x}{2}))$ (c) $e^{\tan(\frac{x}{2})}$ (d)$\log(\cot(\frac{x}{2}))+x$ **Gate(MA): 2000**
Ans. (c) is correct.

66. If $x^h y^k$ is the integrating factor of the differential equation $(3ydx-2xdy)+x^2y^{-1}(10ydx-6xdy)=0$ then the values of h and k are
(a) -3,-3 (b) 2,-3 (c) 2,-2 (d) 2,-2
Ans. (b)

67. Which following is not an I.F. of $xdy-ydx=0$
(a)$\frac{1}{x^2}$ (b)$\frac{1}{x^2+y^2}$ (c)$\frac{1}{xy}$ (d)$\frac{x}{y}$ **Gate(MA): 2001**
Ans. (d) is correct.
Hint. Since $x(\frac{x}{y})dy-y(\frac{x}{y})dx=0$ then $M=-x, N=\frac{x^2}{y}$ and $\frac{\partial M}{\partial y}\neq\frac{\partial N}{\partial x}$.

68. The differential equation $(1+xy)e^{axy}dx+x^2e^{xy}dy=0$ is exact, then the value of a is
(a) 3 (b) 1 (c)-1 (d) None
Ans. (b)

69. Integrating factor of $2x^2\frac{dy}{dx}=1-3xy$ is
(a) $\sqrt{x}$ (b) $-\frac{1}{\sqrt{x}}$ (c) $-\sqrt{x}$ (d) $\frac{1}{\sqrt{x}}$
Ans. (d)

70. The general solution of $p=\log(px-y)$ where $p=\frac{dy}{dx}$ is
(a)$y=cx-c$ (b)$y=cx-e^c$ (c) $y=c^2x-e^{-c}$ (d) none of these **IAS(Prel.)-94, 04**
Ans. (b)

71. The general solution of $y=px+\frac{a}{p}$ where $p=\frac{dy}{dx}$ is
(a)$y=cx+ac$ (b)$y=cx+\frac{a}{c}$ (c) $y=cx+a$ (d) none of these
Ans. (b)

72. The general solution of $p=\cos(y-px)$ where $p=\frac{dy}{dx}$ is
(a)$y=cx+\cos^{-1}c$ (b)$y=cx+\cos c$ (c) $y=cx+\sin c$ (d) $y=cx-c^2$
Ans. (a)

73. The general solution of $y=xp+p^2$ where $p=\frac{dy}{dx}$ is
(a)$y=cx+c^2$ (b)$y=cx+c$ (c) $y=c^2x+c$ (d) none of these **[IAS(Prel.)-97]**
Ans. (a)

74. Which one of the following is Clairaut's equation
(a) $py=px+a$ (b)$y=p^2x+p^4$ (c) $y=px+\frac{1}{p}$ (d) none of these
Ans. (c)

75. The general solution of $y=px+\sqrt{a^2p^2+b^2}$ where $p=\frac{dy}{dx}$ is
(a)$y=cx+\sqrt{a^2c^2+b^2}$ (b)$y=cx-\sqrt{a^2c^2+b^2}$ (c) $y=c-x\sqrt{a^2c^2+b^2}$ (d) none of these
Ans. (a)

76. The singular integral of the ODE $(xy'-y)^2=x^2(x^2-y^2)$ is
(a)$y=x\sin x$ (b)$y=x\sin(x+\frac{\pi}{4})$ (c) $y=x$ (d) $y=x+\frac{pi}{4}$ **[NET(June)-2015]**
Ans. (c)

77. The singular solution of the equation $y=px+f(p)$ where $p=\frac{dy}{dx}$ is obtained on eliminating p between original equation and the equation
(a)$x-f'(p)=0$ (b)$x+f'(p)=0$ (c) $y-f'(p)=0$ (d) $y+f'(p)=0$ **[IAS(Prel.)-98, 07]**
Ans. (b)

78. The singular solution of the equation $xyp^2-(x^2+y^2-1)p+xy=0$ where $p=\frac{dy}{dx}$ is
(a)$y=0$ (b)$y^2=(x-1)^3$ (c) does not exist (d) none of the above **[IAS(Prel.)-04]**
Ans. (b)

79. The singular solution of the equation $y^2(1+\left(\frac{dy}{dx}\right)^2)=r^2$ (where r is a constant) is
(a)$y^2=4x$ (b)$y^2=4r$ (c) $y^2=r^2$ (d) $y^2=r^3$ **[IAS(Prel.)-06]**
Ans. (c)

80. The general solution of the differential equation
$4x^2y''-8xy'+9y=0,\ 0<x<\infty$ is
(a)$c_1e^{\frac{5x}{2}}=c_2e^{-\frac{3x}{2}}$ (b)$c_1e^{\frac{3x}{2}}=c_2e^{-\frac{3x}{2}}$ (c)$(c_1+c_2\log x)x^{\frac{3}{2}}$ (d)$(c_1x^{\frac{3}{2}}+c_2e^{-\frac{3}{2}})$ JAM GP-2005
Ans. (c)

81. The particular solution of the following differential equation
$y''+2y'+5y=\frac{5}{4}e^{\frac{x}{2}}+18\cos 4x-71\sin 4x$ is
(a)$\frac{1}{5}e^{\frac{x}{2}}+2\cos 4x+5\sin 4x$ (b)$\frac{1}{5}e^{\frac{x}{2}}5\sin 4x$
(c)$\frac{1}{5}e^{\frac{x}{2}}-2\cos 4x+6\sin 4x$ (d)$\frac{1}{4}e^{\frac{x}{2}}+6\cos 4x+5\sin 4x$ JAM GP-2005
Ans. (a)

1 The particular integral of the following differential equation
$y''+y'+3y=5\cos(2x+3)$ is
(a)$2\cos(2x+3)-\sin(2x+3)$ (b)$2\sin(2x+3)-\cos(2x+3)$
(c)$2\sin(2x+3)+2\cos(2x+3)$ (d)$5\sin(2x+3)-\cos(2x+3)$ JAM GP-2008
Ans. (b)

82. If e^{2x} and xe^{2x} are particular solutions of a second order homogeneous differential equation with constant coefficients, then the equation is
(a) $y''-4y'+4y=0$ (b) $y''-5y'+4y=0$
(c) $y''-4y=0$ (d) $y''-4y'+6y=0$ [JAM GP-2010]
Ans. (a)

83. All real solution of the differential equation $y''+2ay'+by=\cos x$ are periodic if
(a) $a=1,b=0$ (b)$a=0,b=1$ (c)$a=1,b\neq 0$ (d)$a=0,b\neq 1$ **Gate(MA): 2003**
Ans. (d) is correct.
Hint: For Auxiliary equation we get $m^2+2am+b=0\Rightarrow m=\frac{-2a\pm\sqrt{4a^2-4b}}{2}=-a\pm\sqrt{a^2-b}$ for $a=0,b=1$ the C.F. is $c_1\cos x+c_2\sin x$ and P.I. is $\frac{1}{D^{+}1}\cos x=k\cos x$ where k is constant which is shows that the solution is periodic.

84. Let $f,g:[-1,1]\to R,\quad f(x)=x^3,\ g(x)=x^2|x|.$
Then (a)f and g are linearly independent on $[-1,1]$
(b)f and g are linearly dependent on [-1,1] JAM MA-2009
(c)$f(x)g'(x)-f'(x)g(x)$ is not identically zero on $[-1,1]$
(d)$\exists$ a continuous function $p(x)$ and $q(x)$ s.t that f and g satisfy $y''+py'+qy=0$ on$[-1,1]$
Ans. (b)

85. The solution $y(x)$ of the differential equation
$\frac{d^2y}{dx^2}=4\frac{dy}{dx}+4y=0$ satisfying the equation $y(0)=4,\ \frac{dy}{dx}(0)=8$ is
(a)$4e^2x$ (b)$(16x+4)e^{-2x}$ (c)$4e^{-2x}+16x$ (d)$4e^{-2x}+16xe^{-2x}$ [JAM MA-2011]
Ans. (b)

86. If $y = x \cos x$ is a solution of an n^{th} order linear differential equation $\frac{d^n y}{dx^n} + a_1 \frac{d^{n-1}y}{dx^{n-1}} + \cdots + a_{n-1}\frac{dy}{dx} + a_n y = 0$ with real constant coefficients, then the least possible value of n is
(a) 1 (b) 2 (c) 3 (d) 4 [JAM CA-2011]
Ans. (d)
Hint. Here $\pm i$ are the roots of the required differential equation with multiplicity 2. So, $\cos x,\ \sin x,\ x\cos x,\ x\sin x$ are also the solutions of the said differential equation. Therefore, the least possible value of n is 4.

2 The minimum possible order of a homogeneous linear ordinary differential equation with real constant coefficients having $x^2 \sin(x)$ as a solution is equal to
(a) 2 (b) 4 (c) 5 (d) 6 GATE(MA): 2015
Ans. (d)
Hint. Here $\pm i$ are the roots of the required differential equation with multiplicity 3. So, $\cos x,\ \sin x,\ x\cos x,\ x\sin x,\ x^2\cos x,\ x^2\sin x$ are also the solutions of the said differential equation. Therefore, minimum possible order is 6.

87. For of which the following pair of functions y_1 and y_2 continuous functions $p(x)$ and $q(x)$ can be determined on $[-1, 1]$ such that $y_1(x)$ and $y_2(x)$ give two linearly independent solutions of **GATE(MA)-07**

$$y'' + p(x)y' + q(x)y = 0,\ x \in [-1, 1]$$

A) $y_1(x) = x\sin x,\ \ y_2(x) = \cos x$ B) $y_1(x) = xe^x,\ \ y_2(x) = \sin x$
C) $y_1(x) = e^{x-1},\ \ y_2(x) = e^x - 1$ D) $y_1(x) = x^2,\ \ y_2(x) = \cos x$
Ans. C)
Least possible order of differential equation for solutions (A) or (B) or (D) is 4. (See the example 86) So these solutions are not the solution of the given differential equation.

88. Let $y(x)$ be the solution to the differential equation $4y'' + 12y' + 9y = 0,\ y(0) = 1,\ y'(0) = -4$. Then $y(1)$ equals JAM(MS)-2016
(A)$-\frac{1}{2}e^{-\frac{3}{2}}$ (B) $-\frac{3}{2}e^{-\frac{3}{2}}$ (C) $-\frac{5}{2}e^{-\frac{3}{2}}$ (D) $-\frac{7}{2}e^{-\frac{3}{2}}$
Ans. (B)

89. The general solution of the differential equation $x^2y'' - 5xy' + 9y = 0,\ 0 < x < \infty$ is
(a)$y = (c_1 + c_2x)e^{3x^2}$ (b)$y = (c_1 + c_2x)e^{3x}$
(c)$y = (c_1 + c_2x^2)e^{3x}$ (d)$y = (c_1 + c_2\, ln\, x)x^3$ JAM MA-2005
Ans. (d)

90. The particular integral of the differential equation $y'' - 16y = 4\sinh^2 2x$ is
(a)$\frac{1}{8}(xe^{4x} - xe^{-4x} + 1)$ (b)$\frac{1}{8}(xe^{4x} + xe^{-4x} + 1)$
(c)$\frac{1}{4}(xe^{4x} - xe^{-4x} + 1)$ (d)$\frac{1}{8}(xe^{4x} - xe^{-4x} + 3)$ [JAM CA-2011]
Ans. (a)

91. Let $W(y_1(x),\ y_2(x))$ is the Wronskian form for the solutions $y_1(x)$ and $y_2(x)$ of the differential equation $y'' + a_1y' + a_2y = 0$. If $W \neq 0$ for some $x = x_0$ in $[a,\ b]$ then
(a) it vanishes for any $x \in [a,\ b]$ (b) it does not vanishes for any $x \in [a,\ b]$
(c) it vanishes for only at $x = a$ (d) None [JAM CA-2009]
Ans. (b).

92. Let $W(t)$ is the Wronskian for the solutions $y_1(t)$ and $y_2(t)$ of the differential equation $y''(t) + ay'(t) + by(t) = 0$ with y(0)=0, where a, b are real constants. Then
(a) $w(t) = 0,\ \forall t \in \Re$ (b) $w(t) = c,\ \forall t \in \Re$ for some positive constant c
(c) w is a nonconstant positive function (d) There exist $t_1,\ t_2 \in \Re$ such that $w(t_1) < 0 < w(t_2)$.
Ans. (a). NET(June)-2016

93. Consider the ODE

$$u''(t) + P(t)u' + Q(t)u(t) = R(t),\ \ t \in [0, 1]$$

There exist continuous function P, Q, R defined on $[0, 1]$ and two solutions u_1 and u_2 of the ODE such that the Wronskian W of u_1 and u_2 is
(a) $W(t) = 2t - 1,\ 0 \le t \le 1$ (b) $W(t) = \sin 2\pi t,\ 0 \le t \le 1$
(c) $W(t) = \cos 2\pi t,\ 0 \le t \le 1$ (d) $W(t) = 1,\ 0 \le t \le 1$ **NET(MS)(Jun)-2011**
Ans. (d).
Hint. For two independent solutions u_1 and u_2, $W(u_1, u_2) = W(t) \neq 0,\ 0 \le t \le 1$. Therefore,
(a) $W(t) = 2t - 1,\ 0 \le t \le 1$ is incorrect as $W(t) = 0$ at $t = \frac{1}{2}$,
(b) $W(t) = \sin 2\pi t,\ 0 \le t \le 1$ is incorrect as $W(t) = 0$ at $t = 0, \frac{1}{2}, 1$
(c) $W(t) = \cos 2\pi t,\ 0 \le t \le 1$ is incorrect as $W(t) = 0$ at $t = \frac{1}{4}$
(d) $W(t) = 1,\ 0 \le t \le 1$.
Hint. $W(t) \neq 0,\ \ 0 \le t \le 1$. So (d) is correct.

94. Let $W(y_1, y_2)$ be the wronskian of two linearly independent solution y_1 and y_2 of the equation $y'' + P(x)y' + Q(x)y = 0$. **GATE(MA)-13**
i) The product of $W(y_1, y_2)P(x)$ equals
(A) $y_2y_1'' - y_1y_2''$ (B) $y_1y_2' - y_2y_1'$ (C) $y_1'y_2'' - y_2'y_1''$ (D) $y_2'y_1' - y_1''y_2''$
Ans. (A)
Hint. Wronskian

$$W(y_1, y_2) = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = y_1y_2' - y_2y_1'$$

So, $W'(y_1, y_2) = y_1y_2'' - y_2y_1'' = -W(y_1, y_2)P(x)$ ($\because\ y'' = -P(x)y' - Q(x)y$ or Please see the proof of Theorem **??**).
ii) If $y_1 = e^{2x}$ and $y_2 = xe^{2x}$, then the value of $P(0)$ is
(A) 4 (B) -4 (C) 2 (D) -2
Ans. (B)
Hint. $W(y_1, y_2)P(0) = y_2(0)y_1''(0) - y_1(0)y_2''(0) = 0 \cdot 4 - 1 \cdot 4 = -4$.

95. Let y_1 and y_2 be two linearly independent solutions of $y'' + (\sin x)y = 0,\ 0 < x < 1$. Let $g(x) = W(y_1, y_2)(x)$ be the wronskian of y_1 and y_2. Then **GATE(MA)-08**
A) $g' > 0$ on $[0, 1]$ B) $g' < 0$ on $[0, 1]$
C) g' vanishes at only one point of $[0, 1]$ D) g' vanishes at all points of $[0, 1]$
Ans. D)
Hint. Here $P(0) = 0$, so $g' = W'(y_1, y_2) = -W(y_1, y_2)P(x) = 0$.

96. The Wronskian of the function $f_1(x) = x^2$ and $f_2(x) = x|x|$ is zero for
(a) all x (b) $x > 0$ (c) $x < 0$ (d) $x = 0$ [JAM CA-2005]
Ans. (a)

97. Let $y_1(x)$ and $y_2(x)$ be two linearly independent solutions of
$$x^2y'' - 2xy' - 4y = 0, \ \forall x \in [1, 10].$$
Consider the Wronskian $W(x) = y_1(x)y_2'(x) - y_1'(x)y_2(x)$. If $W(1) = 1$ then $W(3) - W(2)$ equals **JAM-2014**
(A) 1 (B) 2 (C) 3 (D) 5
Ans. (D)
Hint. By Theorem **??**, we have
$$W(x) = W(1) \cdot \exp\Big(\int_1^x \frac{2x}{x^2}dx\Big) = 1 \cdot \exp\Big(\log x^2 - \log 1^2\Big) = x^2.$$
Therefore, $W(3) - W(2) = 5$.

98. Let $y_1(x)$ and $y_2(x)$ be two solutions of
$$(1 - x^2)y'' - 2xy' + (\sec x)y = 0$$
with $W(x)$. If $y_1(0) = 1$, $(\frac{dy_1}{dx})_{x=0} = 0$ and $W(\frac{1}{2}) = \frac{1}{3}$. Then $(\frac{dy_2}{dx})_{x=0} =$ **GATE(MA)-06**
A) $\frac{1}{4}$ B) $\frac{3}{4}$ C) 1 D) $\frac{4}{3}$
Ans. A)
Hint. Since $y_1(x)$ be a solution of the given equation. Hence
$$y_1'' - \frac{2x}{(1-x^2)}y_1' + \frac{(\sec x)}{(1-x^2)}y_1 = 0$$
By using the Theorem **??**, we have, $W(x) = Ce^{\int \frac{2xdx}{1-x^2}} = \frac{C}{1-x^2}$
Given that $W(\frac{1}{2}) = \frac{1}{3} \Rightarrow C = \frac{1}{4} \Rightarrow W(x) = \frac{1}{4(1-x^2)} \Rightarrow W(0) = \frac{1}{4}$
Again we know that, $W(0) = \begin{vmatrix} y_1(0) & y_2(0) \\ y_1'(0) & y_2'(0) \end{vmatrix} \Rightarrow \frac{1}{4} = \begin{vmatrix} 1 & y_2(0) \\ 0 & y_2'(0) \end{vmatrix} \Rightarrow y_2'(0) = \frac{1}{4}$.

99. Let P be a continuous function on $\Re$ and W the Wronskian of two linearly independent solutions y_1 and y_2 of the ODE: $\frac{d^2y}{dx^2} + (1 + x^2)\frac{dy}{dx} + P(x)y = 0, \ x \in \Re$. **NET(MS)-2014**
Let $W(1) = a, \ W(2) = b$ and $W(3) = c$, then
(a) $a < 0$ and $b > 0$. (b) $a < b < c$ or $a > b > c$.
(c) $\frac{a}{|a|} = \frac{b}{|b|} = \frac{c}{|c|}$. (d) $0 < a < b$ and $b > c > 0$.
Ans. (b) and (c).
Hint. By Theorem **??**, we have $W(2) = W(1)e^{-4}$, so $b = ae^{-4}$ and a and b are same sign. Similarly, $W(3) = W(2)e^{-\frac{22}{3}}$, so $c = be^{-\frac{22}{3}}$ and c and b are same sign. Therefore, a, b, c are same sign. Hence the results.

100. Let $y(x) = u(x)\sin x + v(x)\cos x$ be the solution of the differential equation $y'' + 1 = \sec x$. Then $u(x)$ is
(a) $\log|\cos x| + c$ (b)$-x + c$ (c) $x + c$ (d) $\log|\sec x| + c$ [JAM -2015]
Ans. (c)

101. If $y(x)$ be the solution of the differential equation $y'' + 4y = 2e^t$. Then $\lim_{t\to\infty} e^{-t}y(t)$ is equal to
(a) $\frac{2}{3}$ (b)$\frac{2}{5}$ (c) $\frac{2}{7}$ (d) $\frac{2}{9}$ [JAM -2015]
Ans. (b)

102. If general solution of the differential equation $ay''' + by'' + cy' + dy = 0,\ a \neq 0$ is linear spanned by $e^x,\ \sin x$ and $\cos x$, then which one of the following hold?
(a) $a + b - c - d = 0$ (b)$a - b + c - d = 0$
(c) $a + b + c + d = 0$ (d) $a + b - c + d = 0$ [JAM CA-2008]
Ans. (c).
Hint. Since $e^x,\ \sin x$ and $\cos x$ are the solutions of the given differential equation. Putting $y(x) = e^x$ in $ay''' + by'' + cy' + dy = 0$, we get (c).

103. A particular solution of the differential equation
$(D^4 + 2D^2 - 3)y = e^x$ is
(a) $(x + 1)e^x$ (b) $\frac{xe^x}{8}$ (c) xe^x (d) $\frac{xe^x}{4}$ [JAM CA-2005]
Ans. (b)

104. A particular solution of the differential equation
$(D^3 - 3D^2 + 3D - 1)y = e^x\ \cos 2x$ is JAM CA-2005
(a) $-\frac{e^x\ \cos 2x}{8}$ (b) $-\frac{e^x\ \sin 2x}{8}$ (c) $\frac{e^x\ \sin 2x}{8}$ (d) $\frac{e^x\ \cos 2x}{4}$
Ans. (b)

105. The general solution of the differential equation $y''(x) - 4y'(x) + 8y(x) = 10e^x \cos x$ is
(a) $e^{2x}(k_1 \cos 2x + k_2 \sin 2x) + e^{-x}(2\cos x - \sin x)$ (b)$e^{2x}(k_1 \cos 2x + k_2 \sin 2x) + e^x(2\cos x - \sin x)$
(c) $e^{-2x}(k_1 \cos 2x + k_2 \sin 2x) + e^x(2\cos x - \sin x)$ (d) $e^{2x}(k_1 \cos 2x + k_2 \sin 2x) + e^x(2\cos x + \sin x)$
Ans. (b) [JAM CA-2006]

106. The general solution of the differential equation $y''' + y'' - y' - y = 0$ is
(a) $(c_1 + xc_2 + x^2c_3)e^x$ (b)$c_1e^x + (c_2 + xc_3)e^{-x}$
(c) $(c_1 - xc_2 + x^2c_3)e^{-x}$ (d) $(c_1 + xc_2 - x^2c_3)e^{-x}$ [JAM CA-2007]
Ans. (b)

107. Two linearly independent solution of the differential equation $y^{''} - 2y^{'} + y = 0$ are $y_1 = e^x$ and $y_2 = xe^x$. Then particular solution of $y^{''} - 2y^{'} + y = e^x \sin x$ is
(a)$y_1 \cos x + y - 2(\sin x - x\cos x)$ (b)$y_1 \sin x + y_2(x\cos x - \sin x)$
(c)$y_1(x\cos x - \sin x) - y_2 \cos x$ (d)$y_1(x\sin x - \cos x) + y_2 \cos x$ [JAM CA-2008]
Ans. (c)

108. If general solution of the differential equation $y'' - m^2y = 0$ is
(a)$c_1 \sinh mx + c_2 \cosh mx$ (b)$c_1 \sinh mx + c_2 \cos 2mx$
(c) $c_1 \sinh 2mx + c_2 \cosh mx$ (d) $c_1 \sinh mx + c_2 \coth mx$ [JAM CA-2009]
Ans. (a)

109. If a transformation $y = uv$ transforms the given ODE

$$f(x)y^{''} - 4f^{'}(x)y^{'} + g(x)y = 0$$

into the equation of the form $v^{''} + h(x)v = 0$ then u must be **GATE(MA)-12**
A) $\frac{1}{f^2}$ B) xf C) $\frac{1}{2f}$ D) f^2
Ans. D)

110. Suppose $y_p(x) = x\cos 2x$ is a particular solution of

$$y^{''} + \alpha y = -4\sin 2x$$

then the constant α equals **GATE(MA)-07**
A) -4 B) -2 C) 2 D) 4.
Ans. D)

111. A Particular solution of $x^2\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} + \frac{y}{4} = \frac{1}{\sqrt{x}},\ 0 < x < \infty$ is **GATE(MA)-06**
A) $\frac{1}{2\sqrt{x}}$ B) $\frac{\log x}{2\sqrt{x}}$ C) $\frac{(\log x)^2}{2\sqrt{x}}$ D) $\frac{(\log x)\sqrt{x}}{2}$
Ans. C)

112. If $y = \phi(x)$ is particular solution of

$$y'' + (\sin x)y' + 2y = e^x$$

and $y = \psi(x)$ is a particular solution of

$$y'' + (\sin x)y' + 2y = \cos 2x$$

then a particular solution of

$$y'' + (\sin x)y' + 2y = e^x + \cos 2x$$

is given by **GATE(MA)-04**

A) $\phi(x) - \psi(x) + \frac{1}{2}$ B) $\psi(x) - \phi(x) + \frac{1}{2}$ C) $\phi(x) + \psi(x)$ D) $\psi(x) - \phi(x) + 1$
Ans. C)

113. Let $y_1(x) = 1 + x$ and $y_2(x) = e^x$ be two solutions of

$$y''(x) + P(x)y'(x) + Q(x)y(x) = 0$$

(i) $P(x) =$ A) $1 + x$ B) $-1 - x$ C) $\frac{1+x}{x}$ D) $\frac{-1-x}{x}$ **GATE(MA)-09**
Ans. D)
(ii) The set of initial conditions for which the above ODE has no solution is
A) $y(0) = 2, y'(0) = 1$ B) $y(1) = 1, y'(1) = 0$ C) $y(1) = 0, y'(1) = 1$ D) $y(2) = 1, y'(2) = 1$
Ans. A)

114. If $y(x) = x$ is a solution of the differential equation

$$y'' - \left(\frac{2}{x^2} + \frac{1}{x}\right)(xy' - y) = 0,\ 0 < x < \infty$$

then its general solution is **GATE(MA)-09**
A) $(\alpha + \beta e^{-2x})x$ B) $(\alpha + \beta e^{2x})x$ C) $\alpha x + \beta e^x$ D) $(\alpha e^x + \beta)x$
Ans. D)
Hint. As $y(x) = x$ is a solution so $y(x) = xv(x)$ be another independent solution. Finding the values of $v(x)$, we get (D).

115. The value of $\frac{1}{xD+1}(x^{-1})$, $0 < x < \infty$ is **GATE(MA)-09**
A) $\log x$ B) $\frac{\log x}{x}$ C) $\frac{\log x}{x^2}$ D) $\frac{\log x}{x^3}$
Ans. B)
Hint. The differential equation is

$$x\frac{dy}{dx} + y = \frac{1}{x}$$

which is a Linear equation. The solution is $y = \frac{logx}{x}$, $0 < x < \infty$.

116. If $y_1(t)$ and $y_2(t)$ be linearly independent solution of the differential equation $y'' + P(x)y' + Q(x)y = 0$, where P and Q are continuous function on an interval I. Then $y_3(x) = ay_1(x) + by_2(x)$ and $y_4(x) = cy_1(x) + dy_2(x)$ are linearly independent solutions of the given differential equation if
(a) $ad \neq bc$ (b) $ad = bc$ (c) $ab = cd$ (d) $ab \neq cd$ [JAM MA-2008]
Ans. (a)

117. The set of linearly independent solutions of the differential equation $\frac{d^4y}{dx^4} - \frac{d^2y}{dx^2} = 0$ is
A) $\{1, x, e^x, e^{-x}\}$ B) $\{1, x, e^x, xe^x\}$ C) $\{1, x, e^{-x}, xe^{-x}\}$ D) $\{1, x, e^x, xe^{-x}\}$ **GATE(MA)-05**
Ans. (A)

118. One particular solution of $y''' - y'' - y' + y = -e^x$ is a constant multiple of
A) xe^{-x} B) xe^x C) x^2e^{-x} D) x^2e^x **GATE(MA)-08**
Ans. (D)

119. If $y_1(x) = x$ is a solution to the ODE

$$(1 - x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$$

then its general solution is **GATE(MA)-14**
A) $y(x) = c_1x + c_2(x \ln|1 + x^2| - 1)$ B) $y(x) = c_1x + c_2(x \ln|\frac{1-x}{1+x}| - 1)$
C) $y(x) = c_1x + c_2(\frac{x}{2} \ln|1 - x^2| + 1)$ D) $y(x) = c_1x + c_2(\frac{x}{2} \ln|\frac{1+x}{1-x}| - 1)$
Ans. D)

120. If $y_1(x)$ and $y_2(x)$ form a fundamental set of solutions of $y'' + p(x)y' + q(x)y = 0,\ a \leq x \leq b$, where p and q are real-valued continuous function on an interval $[a,\ b]$. If x_0 and x_1 with $x_0 < x_1$ are consecutive zeros of $y_1(x)$ in (a, b), then
(a) $y_1(x) = (x - x_0)q_0(x)$ where $q_0(x)$ is continuous on $[a, b]$ with $q_0(x_0) \neq 0$,
(b) $y_1(x) = (x - x_0)^2p_0(x)$ where $p_0(x)$ is continuous on $[a, b]$ with $p_0(x_0) \neq 0$,
(c) $y_2(x)$ has no zeros in (x_0, x_1)
(d) $y_2(x) = 0$ but $y_2'(x_0) \neq 0$ **[NET(MS)(Dec.)2011]**
Ans. (a)

121. If $y_1(x)$ and $y_2(x)$ form a fundamental set of solutions of $y'' + p(x)y' + q(x)y = 0,\ a \leq x \leq b,$, where p and q are continuous in $[a,\ b]$ and x_0 is a point in (a, b). Then,
(a) both $y_1(x)$ and $y_2(x)$ can not have a local maximum at x_0
(b) both $y_1(x)$ and $y_2(x)$ can not have a local minimum at x_0
(c) $y_1(x)$ can not have a local maximum at x_0 and $y_2(x)$ can not have a local minimum at x_0 simultaneously
(d) both $y_1(x)$ and $y_2(x)$ can not vanish at x_0 simultaneously **[NET(MS)(Dec.)2011]**
Ans. (a), (b), (c), (d).

122. Consider the equation of an ideal planer pendulum $\frac{d^2x}{dt^2} = -\sin x$ where x denotes the angle of displacement. For sufficiently small angles of displacement, the solution is given by (where A and B) are arbitrary constants **NET(MS): (June)2013**
(a) $x(t) = A\cosh t + B\sinh t$ (b) $x(t) = A + Bt$
(c) $x(t) = Ae^t + Be^{2t}$ (d) $x(t) = A\cos t + B\sin t$
Ans. (d).

123. If $y = \frac{(c_1+c_2 \ln x)}{x}$, $0 < x < \infty$ is the general solution of the differential equation $x^2y'' + kxy' + y = 0,\ 0 < x < \infty$ then k equals

(a) 3 (b) -1 (c) 3 (d) 1 [JAM MA-2006]
Ans. (b)

124. Let $1, x$ and x^2 be the solutions of a second order linear non-homogeneous differential equation on $-1 < x < 1$. Then its general solution, involving arbitrary constants c_1 and c_2 ,can be written as
(a)$c_1(1-x)+c_2(x-x^2)+1$ (b)$c_1x+c_2x^2+1$
(a)$c_1(1+x)+c_2(1+x^2)+1$ (d)$c_1+c_2x+x^2$ [JAM MS-2007]
Ans. (d)

3 The substitution $x = e^z$ transforms the ODE $x^2\frac{d^2y}{dx^2} - 5y = \log x$, $0 < x < \infty$ to
(a)$\frac{d^2y}{dz^2}+\frac{dy}{dz}-5y=z$ (b)$\frac{d^2y}{dz^2}-\frac{dy}{dz}+5y=z$ (c) $\frac{d^2y}{dz^2}-\frac{dy}{dz}+3y=z$ (d) $\frac{d^2y}{dz^2}-\frac{dy}{dz}-5y=z$
Ans: (d)

4 The particular integral of $(D^2-4D+4)y = x^3e^{2x}$ is
(a)$\frac{e^{2x}x^4}{20}$ (b)$\frac{e^{2x}x^5}{20}$ (c) $\frac{e^{2x}x^4}{60}$ (d) $\frac{e^{2x}x^5}{20}$
Ans: (b) or (d)

5 The auxiliary equation of $\frac{d^2y}{dx^2}+a^2y = \sec ax, (a \neq 0)$, is
(a) $m^2+a^2=0$ (b) $m^2+2a^2=0$ (c) $m^2+a=0$ (d) none of these
Ans: (a)

125. The General solution of the differential equation $\frac{d^4y}{dx^4} - y = x\sin x$ is
(a) $\frac{x^2}{8}\cos x+\frac{1}{4}x\sin x$ (b)$\frac{x^2}{8}\cos x-\frac{1}{4}x\sin x$
(c)$\frac{x^2}{8}\sin x+\frac{1}{4}x\cos x$ (d)$\frac{x^2}{8}\sin x-\frac{1}{4}x\cos x$ **Gate(MA): 2002**
Ans. (a) is correct.

126. The general solution of the ordinary differential equation $\frac{d^2y}{dx^2}+4y=0$ is
(a)Ae^x+Be^{-2x} (b)$(A+Bx)e^{2x}$ (c) $A\cos 2x+B\sin 2x$ (d) $(A+Bx)\cos 2x$
Ans: (c)

127. The differential equation whose independent solutions are cos $2x$, sin $2x$ and e^{-x} is
(a)$(D^3+D^2+4D+4)y=0$ (b)$(D^3+-D^2+4D-4)y=0$
(c)$(D^3+D^2-4D-4)y=0$ (d)$(D^3-D^2-4D+4)y=0$ **Gate(MA): 2002**
Ans. (a) is correct.
Hint: Let $y = c_1\cos 2x + c_2\sin 2x + c_3e^{-x}$ be the solution then $(D^3+D^2+4D+4)y = 0$.

128. $\frac{1}{D-1}x^2$ is equal to
(a)x^2+2x+2 (b)$-(x^2+2x+2)$ (c) $2x-x^2$ (d) $-(2x-x^2)$
Ans. (b)

129. The general solution of the ordinary differential equation $\frac{d^2y}{dx^2}+9y=0$ is
(a)$Ae^{3x}+Be^{-3x}$ (b)$(A+Bx)e^{3x}$ (c) $A\cos 3x+B\sin 3x$ (d) $(A+Bx)\sin 3x$
Ans. (c)

130. $\frac{1}{D^2+4}\sin 2x$ is equal to
(a)$\frac{-x\cos 2x}{4}$ (b)$\frac{-x\sin 2x}{4}$ (c) $\frac{\cos 2x}{4}$ (d) $\frac{x\cos 2x}{4}$
Ans. (a)

131. The maximum number of linearly independent solutions of the ordinary differential equation $\frac{d^4y}{dx^4} = 0$ with the condition $y(0) = 1$ is
(a)4 (b)3 (c) 2 (d) 1 **[GATE-2010]**
Ans. (a)
Hint. The order of the ODE is 4, so the number of independent solutions are 4. Also the given condition does not reduced the number of independent solutions. Hence the result.

132. $\frac{1}{D^2+4} \sin 3x$ is equal to
(a)$\frac{\cos 3x}{5}$ (b)$\frac{-\sin 3x}{5}$ (c) $\frac{-\cos 3x}{5}$ (d) $\frac{\sin 3x}{5}$
Ans. (b)

133. The general solution of the ordinary differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$ is
(a)$Ae^x + Be^{-x}$ (b)$(A + Bx)e^{-x}$ (c) $Axe^{-x} + Bxe^x$ (d) $(A + Bx)\sin 3x$
Ans. (b)

134. The substitution $x = e^z$ transforms the differential equation $x^2\frac{d^2y}{dx^2} - y = \log x \sin(\log x),\ 0 < x < \infty$ to
(a)$\frac{d^2y}{dz^2} + \frac{dy}{dz} - y = z \log z$ (b)$\frac{d^2y}{dz^2} - \frac{dy}{dz} - y = z \sin z$
(c) $\frac{d^2y}{dz^2} - \frac{dy}{dz} + y = z^2$ (d) $\frac{d^2y}{dz^2} - \frac{dy}{dz} - y = z$
Ans. (b)

135. The general solution of the differential equation with constant coefficients $\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0$ approaches zero as $x \to \infty$, if **JAM(MA)-2016**
(a) b is negative and c is positive (b) b is positive and c is negative
(c) both b and c are positive (d) both b and c are negative.
Ans. (c)

136. Assume that all zeros of the polynomial $a_nx^n + a_{n-1}x^{n-1} + \cdots + a_1x + a_0$ have negative real parts. If $u(t)$ is any solution of the ODE

$$a_n\frac{d^nu}{dt^n} + a_{n-1}\frac{d^{n-1}u}{dt^{n-1}} + \cdots + a_1\frac{du}{dt} + a_0u = 0$$

then $\lim_{t\to\infty} u(t)$ is equal to A) 0 B) 1 C) $n - 1$ D) ∞ **GATE(MA)-13**
Ans. A)
Hint. $u(t) = \sum_{k=1}^{n} A_ie^{(-\alpha_k+i\beta_k)t},\ \alpha_k > 0.$

137. If $y_1(x)$, $y_2(x)$ are solutions of $y'' + xy' + (1 - x^2)y = \sin x$, then which of the following is also its solution ?.
(a) $y_1(x) + y_2(x)$ (b) $y_1(x) - y_2(x)$ (c) $2y_1(x) - y_2(x)$ (d) $y_1(x) - 2y_2(x)$
Ans. (c).

138. Let y_1 and y_2 be twice differentiable functions on a interval I satisfying the differential equations $y_1' - y_1 - y_2 = e^x$ and $2y_1' + y_2' - 6y_1 = 0$. Then $y_1(x)$ is
(a) $c_1e^{-2x} + c_2e^{3x} - \frac{1}{4}e^x$ (b) $c_1e^{2x} + c_2e^{-3x} - \frac{1}{4}e^x$ (c) $c_1e^{-2x} + c_2e^{-3x} - \frac{1}{8}e^x$
(d) $c_1e^{3x} + c_2e^{-2x} - \frac{1}{4}e^x$ [JAM MA-2008]
Ans. (b)

139. Consider the system of ODE $\frac{dY}{dx} = AY,\ Y(0) = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ where $A = \begin{pmatrix} 1 & 2 \\ 0 & -1 \end{pmatrix}$ and $Y(x) = \begin{pmatrix} y_1(x) \\ y_2(x) \end{pmatrix}$

NET(MS): (June)2012
(a) $y_1(x) \to \infty$ and $y_2(x) \to 0$ as $x \to \infty$
(b) $y_1(x) \to 0$ and $y_2(x) \to 0$ as $x \to \infty$
(c) $y_1(x) \to \infty$ and $y_2(x) \to -\infty$ as $x \to -\infty$
(d) $y_1(x) \to \infty$ and $y_2(x) \to -\infty$ as $x \to -\infty$
Ans. (a) and (c).

140. Let $Y(x) = \begin{pmatrix} y_1(x) \\ y_2(x) \end{pmatrix}$ satisfy $\frac{dY}{dx} = AY,\ t > 0,\ Y(0) = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ where A is a 2×2 constant matrix with real entries satisfying $trace\,A = 0$ and $det\,A > 0$. Then $y_1(x)$ and $y_2(x)$ both are **NET(MS): (Dec.)2012**
(a) monotonically decreasing functions of t.
(b) monotonically increasing functions of t.
(c) oscillating functions of t.
(d) constant functions of t.
Ans. (c).

141. Consider the first order system of linear equations $\frac{dX}{dt} = AX$ where $A = \begin{pmatrix} 3 & 2 \\ -2 & -1 \end{pmatrix}$ and $X(t) = \begin{pmatrix} x_1(t) \\ x_2(t) \end{pmatrix}$. Then **NET(MS): (Dec.)2011**
(a) the coefficient matrix A has a repeated eigenvalue $\lambda = 1$.

(b) there is only one linearly independent eigenvector $X_1 = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$.

(c) the general solution of the ODE is $(aX_1 - bX_2)e^t$, where a and b are arbitrary constants and $X_1 = \begin{pmatrix} 1 \\ -1 \end{pmatrix},\ X_2 = \begin{pmatrix} t \\ \frac{1}{2} - t \end{pmatrix}$.

(d) the vectors X_1 and X_2 in the option (c) given above are linearly independent

Ans. (a), (b), (c) and (d).

142. The general solution $\begin{pmatrix} x(t) \\ y(t) \end{pmatrix}$ of the system

$$\dot{x} = -x + 2y$$
$$\dot{y} = 4x + y$$

is given by **GATE(MA)-04**

A) $\begin{cases} C_1e^{3t} - C_2e^{-3t} \\ 2C_1e^{3t} + C_2e^{-3t} \end{cases}$ B) $\begin{cases} C_1e^{3t} \\ C_2e^{-3t} \end{cases}$ C) $\begin{cases} C_1e^{3t} + C_2e^{-3t} \\ 2C_1e^{3t} + C_2e^{-3t} \end{cases}$ D) $\begin{cases} C_1e^{3t} - C_2e^{-3t} \\ -2C_1e^{3t} + C_2e^{-3t} \end{cases}$
Ans. A)

143. Let $A = \begin{pmatrix} -2 & 1 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & -2 \end{pmatrix},\ x(t) = \begin{pmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{pmatrix}$ and $|x(t)| = \sqrt{(x_1^2(t) + x_2^2(t) + x_3^2(t))}$. Then any

solution of the first order system of the ordinary differential equation **NET(JUNE)-16**

$$\dot{x}(t) = Ax(t), \quad \mathbf{x(0) = 0}$$

satisfies

(a) $\lim_{t\to\infty} |x(t)| = 0$ (b) $\lim_{t\to\infty} |x(t)| = \infty$ (c) $\lim_{t\to\infty} |x(t)| = 2$ (d) $\lim_{t\to\infty} |x(t)| = 12$.

Ans. (a).

144. Let $a, b \in R$. Let $y = (y_1, y_2)'$ be a solution of the system of equations

$$y_1' = y_2, \quad y_2' = ay_1 + by_2$$

Every solution $y(x) \to 0$ as $x \to \infty$ if **GATE(MA)-08**

A) $a < 0, b < 0$, B) $a < 0, b > 0$, C)$a > 0, b > 0$ D) $a > 0, b < 0$

Ans. A)

145. Let k be a real constant. The solution of the differential equations $\frac{dy}{dx} = 2y + z$ and $\frac{dz}{dx} = 3y$ satisfies the relation

(a) $y - z = ke^{3x}$ (b)$3y + z = ke^{3x}$

(c) $3y - z = ke^{3x}$ (d) $y + z = ke^{3x}$ [JAM CA-2008]

Ans. (b)

146. If $y_1'(x) = 3y_1(x) + 4y_2(x)$ and $y_2'(x) = 4y_1(x) + 3y_2(x)$ then $y_1(x)$ is

(a) $c_1e^{-x} + c_2e^{7x}$ (b)$c_1e^{x} + c_2e^{7x}$

(c) $c_1e^{-x} + c_2e^{-7x}$ (d) $c_1e^{x} + c_2e^{-7x}$ [JAM CA-2006]

Ans. (a)

147. The general solution of

$$y + \frac{dz}{dx} = 0$$
$$\frac{dy}{dx} - z = 0$$

is given by **GATE(MA)-05**

A) $\begin{cases} y = \alpha e^x + \beta e^{-x} \\ z = \alpha e^x \beta e^{-x} \end{cases}$ B) $\begin{cases} y = \alpha\cos x + \beta\sin x \\ z = \alpha\sin x - \beta\cos x \end{cases}$ C) $\begin{cases} y = \alpha\sin x - \beta\cos x \\ z = \alpha\cos x + \beta\sin x \end{cases}$ D) $\begin{cases} y = \alpha e^x \beta e^{-x} \\ z = \alpha e^x + \beta e^{-x} \end{cases}$

Ans. C)

148. The general solution of $\frac{dx}{z} = \frac{dy}{0} = \frac{dz}{-x}$ is given by

A) $y = c_1, x^2 + z^2 = c_2$ B) $y + x = c_1, x^2 + z = c_2$ C) $x = c_1, x + z^2 = c_2$ D) $y^2 + x = c_1, x + z = c_2$

Ans. A)

149. The set of all eigenvalues of the S-L problem $y'' + \lambda y = 0$ with $y'(0) = 0$, $y'(\frac{\pi}{2}) = 0$ is given by

(a)$\lambda = 2n,\ n = 1, 2, 3, \cdots$ (b)$\lambda = 2n, n = 0, 1, 2, \cdots$

(c)$\lambda = 4n^2, n = 1, 2, 3, \cdots$ (d)$\lambda = 4n^2, n = 0, 1, 2, \cdots$ **Gate(MA): 2004**

Ans. (d) is correct.

Hint. The solution of the differential equation $y'' + \lambda y = 0$ is $y(x) = a_1 + a_2x, \lambda = 0$, $y(x) = b_1e^{\sqrt{-\lambda}} + b_2e^{-\sqrt{-\lambda}}, \lambda < 0$ and $y(x) = c_1\cos\sqrt{\lambda}x + c_2\sin\sqrt{\lambda}x, \lambda > 0$. Using given boundary conditions, we get, a_1 is arbitrary for $\lambda = 0$, $b_1 = b_2 = 0$ for $\lambda < 0$ and $c_2 = 0$, $c_1 \neq 0 \Rightarrow \sin\sqrt{\lambda}\frac{\pi}{2} = 0 \Rightarrow \sqrt{\lambda}\frac{\pi}{2} = n\pi$ for $n = 1, 2, 3, \cdots$ or $\lambda = 4n^2$ for $n = 1, 2, 3, \cdots$ for $\lambda > 0$. Hence eigenvalues of the S-L problem is $\lambda = 4n^2, n = 0, 1, 2, \cdots$.

150. Let $f : \mathbb{R} \Rightarrow \mathbb{R}$ be a twice continuously differentiable function, with $f(0) = f(1) = f'(0) = 0$. Then **NET(Dec.): 2015**
(a) f'' is the zero function (b) $f''(0)$ is zero
(c) $f''(x) = 0$ for some $x \in (0, 1)$ (d) f'' never vanishes.
Ans. (c)
Hint. Please see the section **??**.
151. Let $y(x)$ be the solution of the initial value problem $x^2y'' + xy' + y = x$, $y(1) = y'(1) = 1$, then the value of $y(e^{\frac{\pi}{2}})$ is **GATE(MA)-10**
A) $\frac{1}{2}(1 - e^{\frac{\pi}{2}})$ B) $\frac{1}{2}(1 + e^{\frac{\pi}{2}})$ C) $\frac{1}{2} + \frac{\pi}{4}$ D) $\frac{1}{2} - \frac{\pi}{4}$.
Ans. B)
Hint. Taking $x = e^z$ and the solution is $y(x) = \frac{1}{2}\cos(\log x) + \frac{1}{2}\sin(\log x) + e^x$, $x > 0$.
152. Let $y(x)$ be the solutions of the differential equation, $\frac{d}{dx}\left(x\frac{dy}{dx}\right) = x$, $y(1) = 0$, $\left(\frac{dy}{dx}\right)_{x=1} = 0$. Then $y(2)$ is **JAM(MA)-2016**
A) $\frac{3}{2} + \frac{1}{2}\ln 2$ B) $\frac{3}{2} - \frac{1}{2}\ln 2$ C) $\frac{3}{2} + \ln 2$ D) $\frac{3}{2} - \ln 2$.
Ans. B)
153. The sturm-Liouville problem $y'' + (\lambda)^2 y = 0, y'(0) = 0, y'(\pi) = 0$ has its eigenvectors given by $y =$
(a) $\sin(n + \frac{1}{2})x$ (b) $\sin nx$ (c) $\cos(n + \frac{1}{2})x$ (d) $\cos nx$ **Gate(MA): 2000**
Ans. (d) is correct.
Hint: Where $\lambda = 0$ the solution is trivial. The solution of given differential equation is, $y = c_1\cos\lambda x + c_2\sin\lambda x$. Now $y' = \lambda(-c_1\sin\lambda x + c_2\cos\lambda x)$. Now $y'(0) = 0$ we get, $c_2 = 0$, and $c_1\sin\lambda\pi = 0$. For $c_1 = 0$, solution is trivial. Now let $c_1 \neq 0$ then $\sin(\lambda\pi) = 0$ or, $\lambda\pi = n\pi$, $n \in Z$ or $\lambda = n$, thus $\lambda_n = n$. In other words λ_n be equal to one of the number $0, 1, 2, \cdots$. The eigenfunction is, $y_n = A_n\cos nx$.
154. Let $y(x)$ be the solution of the initial value problem
$$y''' - y'' + 4y' - 4y = 0,\ y(0) = y'(0) = 2,\ y''(0) = 0$$
then the value of $y(\frac{\pi}{2})$ is, **GATE(MA)-10**
A) $\frac{1}{5}(4e^{\frac{\pi}{2}} - 6)$ B) $\frac{1}{5}(6e^{\frac{\pi}{2}} - 4)$ C) $\frac{1}{5}(8e^{\frac{\pi}{2}} - 2)$ D) $\frac{1}{5}(8e^{\frac{\pi}{2}} + 2)$.
Ans. C)
Hint. The solution is $y(x) = \frac{8}{5}e^x + (\frac{2}{5}\cos 2x + \frac{1}{5}\sin 2x)$.
155. The solution of the differential equation $\frac{d^2y}{dx^2} - y = e^x$ satisfying the boundary conditions $y(0) = 0$ and $\frac{dy}{dx}(0) = \frac{3}{2}$ is
(a)$y(x) = \sinh x + \frac{x}{2}e^x$ (b)$y(x) = \sinh x - \frac{x}{2}e^x$
(c)$y(x) = \cosh x + \frac{x}{2}e^x$ (d)$y(x) = x\cosh x + \frac{x}{2}e^x$ [JAM CA-2010]
Ans. (a)
156. The solution to the initial value problem
$$\frac{d^2y}{dt^2} + \frac{dy}{dt} + 5y = 3e^{-t}\sin t,\ y(0) = 0,\ \left(\frac{dy}{dt}\right)_{x=0} = 2$$

is **GATE(MA)-14**
A) $y(t) = e^t(\sin t + \sin 2t)$ B) $y(t) = e^{-t}(\sin t + \sin 2t)$ C) $y(t) = 3e^t \sin t$ D) $y(t) = 3e^{-t} \sin t$.
Ans. B)

157. Consider the differential equation $y'' + 6y' + 25y = 0$ with initial condition $y(0) = 0$. Then the general solution of the IVP is
(a)$e^{-3x}(A\cos 4x + B\sin 4x)$ (b)$Be^{-3x}\sin 4x$
(c)$e^{-3x}(A\cos 4x + B\sin 3x)$ (d)$e^{-3x}(A\cos 3x + B\sin 3x)$ [JAM GP-2006]
Ans. (b)

158. The differential equation $y'' + y = 0$ satisfying $y(0) = 1$ and $y(\pi) = 0$ has
(a) a unique solution (b) a single infinite family of solutions
(c) no solution (d)A double infinity family of solutions [JAM GP-2008]
Ans. (b)

159. The solution of the differential equation $y'' + 4y = 0$ subject to $y(0) = 1$, $y'(0) = 2$ is
(a) $\sin 2x + 2\cos 2x$ (b) $\sin 2x - \cos 2x$ (c) $\sin 2x + \cos 2x$ (d) $\sin 2x + 2x$
Ans. (c) [JAM CA-2005]

160. The solution of the boundary value problem
$y'' + y = cosecx,\ 0 < x < \frac{\pi}{2},\ y(0) = 0,\ y(\frac{\pi}{2}) = 0$ is **NET(MS): (June)2012**
(a) convex (b) concave (c) negative (d) positive
Ans. (b) and (c)

161. Let V be the set of all bounded solutions of the ODE
$u''(t) - 4u'(t) + 3u(t) = 0,\ t \in \Re$, Then V **NET(MS): (June)2012**
(a) is a real vector space of dimension 2 (b) is a real vector space of dimension 1
(c) contains only the trivial solution $u = 0$ (d) contains exactly two solution
Ans. (c)
Hint. $u(t) = Ae^{3t} + Be^t$. Since $u(t)$ is bounded for all t. As $t \to \infty$, $u(t)$ is bounded. Hence $A = B = 0$. Therefore, $u = 0$ is the only solution for this problem.

162. Let V be the set of all solution of the equation $y'' + ay' + by = 0$ satisfying $y(0) = y(1)$, where a, b are positive real numbers. Then the dimension(V) is equal to **GATE(MA): 2016**
(a) 2 (b) 1 (c) 0 (d) 3.
Ans. (b)
Hint. Here $V = \{Ay_1(x) + By_2(x) : 0 \le x \le 1\}$. Using boundary condition, we get, $A = f(B)$. Hence V contains only one arbitrary constant either A or B. So dimension(V)=1.

163. The boundary value problem $y'' + \lambda y = 0$ satisfying $y(-\pi) = y(\pi)$ and $y'(-\pi) = y'(\pi)$ to each eigenvalue λ, there corresponds **NET(MS): (June)2011**
(a) only one eigenfunction (b) two eigenfunctions
(c) two linearly independent eigenfunctions (d) two orthogonal eigenfunctions
Ans. (c) and (d).
Hint. See properties of Sturm-Liouville problems.

164. For the Sturm Liouville problems

$$(1 + x^2)y'' + 2xy' + \lambda x^2 y = 0$$

with $y^{'}(1) = 0$ and $y^{'}(10) = 0$ the eigenvalues, λ, satisfy **GATE(MA)-03**

A) $\lambda \geq 0$ B) $\lambda < 0$ C) $\lambda \neq 0$ D) $\lambda \leq 0$.
Ans. A)

165. Consider the BVP $u'' = -f(x)$, $u(0) = u''(1) = 0$ on $[0, 1]$. Then which of the following are correct ? **NET(MS): (June)2013**
(a) The Green's function $G(x, \zeta)$, $(x, \zeta) \in [0, 1] \times [0, 1]$ for the above BVP is

$$\begin{aligned} G(x,\zeta) &= x,\ 0 \leq x \leq \zeta \\ &= \zeta,\ \zeta \leq x \leq 1 \end{aligned}$$

(b) Both G and $\frac{\partial G}{\partial x}$ are continuous on $[0, 1] \times [0, 1]$ with $\frac{\partial^2 G}{\partial x^2}$ having a discontinuity along $x = \zeta$
(c) $G(x, \zeta)$ satisfies the homogeneous equation $u'' = 0$ for $0 \leq x \leq \zeta$ and $\zeta \leq x \leq 1$
(d) The solution of the given BVP is $u(x) = \int_0^x \zeta f(\zeta) d\zeta + \int_x^1 x f(\zeta) d\zeta$
Ans. (a), (c), (d). (Remark. Here three answers are correct).

166. Consider the BVP $u''(x) + \pi^2 u(x) = 0$, $x \in (0, 1)$, $u(0) = u(1) = 0$. If u and u' are continuous on $[0, 1]$, then **NET(MS): (June)2014**
(a) $\int\limits_0^1 u'^3(x)dx = 0$ (b) $u'^2(x) + \pi^2 u^2(x) = u'^2(0)$
(c) $u'^2(x) + \pi^2 u^2(x) = u'^2(1)$. (d) $\int\limits_0^1 u'^2(x)dx = \pi^2 \int\limits_0^1 u^2(x)dx$
Ans. (b), (c), (d).
Hint. $u(x) = A\cos \pi x + B \sin \pi x$. Using boundary conditions, we get $A = 0$. Therefore $u(x) = B \sin \pi x \Rightarrow u'(x) = B\pi \cos \pi x$. Hence the results.

167. The orthogonal transformation $y = k(x - 1), k \in IR$ is
(a)$(x - 1)^2 + (y - 1)^2 = c^2$ (b)$x^2 + y^2 = c^2$ (c)$x^2 + (y - 1)^2 = c^2$
(d) $(x - 1)^2 + y^2 = c^2$ **Gate(MA): 2004**
Ans. (d) is correct.
Hint: Here $\frac{dy}{dx} = k$ so, $y = y'(x - 1)$ is a differential equation of given curve. Now for orthogonal transformation we get, $y = -\frac{1}{y'}(x - 1)$ or $\frac{y^2}{2} = (-\frac{x^2}{2} + x) + c^2$ or $(x - 1)^2 + y^2 = c^2$.

168. The orthogonal transformation of the family of circle $x^2 + y^2 = 2cx$ is described by the differential equation
(a)$(x^2 + y^2)y' = 2xy$ (b)$(x^2 - y^2)y' = 2xy$
(c)$(y^2 - x^2)y' = xy$ (d)$(y^2 - x^2)y' = 2xy$ **Gate(MA): 2003**
Ans. (b) is correct.
Hint.: From the circle $x + yy' = c$. Then by circle, we get $(x^2 + y^2) = 2x(x + yy')$ or $-x^2 + y^2 = 2xyy'$. For orthogonal trajectory we get $(-x^2 + y^2) = 2xy(-\frac{1}{y'})$ or $(x^2 - y^2)y' = 2xy$.

169. The general solution of the differential equation $yy'' - (y')^2 = 0$ is
(a)$y = c_2 e^{c_1 x^2}$ (b)$y = (c_2 + x)e^{c_1 x^2}$ (c)$y = (c_2 - x)e^{c_1 x^2}$ (d)$y = c_2 e^{c_1 x}$ [JAM CA-2009]
Ans. (d)

170. The differential equation representing the family of circles touching y- axis at the origin is
(a) Non linear and of first order (b) linear and of second order
(c) exact and linear but not homogeneous (d) exact, homogeneous and linear [JAM MA-2006; IAS(Prel.) 1997]
Ans. (a)

171. The orthogonal trajectories of the family of the curves $(x-1)^2+(\frac{d^2y}{dx^2})^2 ax = 0$ are the solution of the differential equation
(a) $x^2 - y^2 - 1 + 2xy\frac{dy}{dx} = 0$ (b)$x^2 - y^2 - 1 - 2xy\frac{dy}{dx} = 0$
(c) $x^2 - y^2 - 1 + 3xy\frac{dy}{dx} = 0$ (d) $x^2 + y^2 - 1 - 2xy\frac{dy}{dx} = 0$ [JAM CA-2008]
Ans. (b)

172. The orthogonal trajectories of the curves
$y^2 = 3x^3 + x + c$ are
(a) $2\tan^{-1} 3x + 3ln|y| = k$ (b)$3\tan^{-1} 3x + 2ln|y| = k$
(c) $3\tan^{-1} 3x - 3ln|y| = k$ (d) $2\tan^{-1} 3x - 3ln|y| = k$ [JAM CA-2006]
Ans. (a)

173. Which one of the following differential equations represents all circle with radius a?
(a)$1 + (\frac{dy}{dx})^2 + \sqrt{a^2 - x^2}\frac{d^2y}{dx^2} = 0$ (b)$1 + (\frac{dy}{dx})^2 + \sqrt{a^2 - x^2}\frac{d^2y}{dx^2} = 0$
(c)$1 + (\frac{dy}{dx})^2 + \sqrt{a^2 - x^2}\frac{d^2y}{dx^2} = 0$ (d)$[1 + (\frac{dy}{dx})^2]^3 = a^2(\frac{d^2y}{dx^2})^2$ [JAM CA-2008]
Ans. (d)

174. The general solution of the differential equation $y'' = (y')^2$ is
(a)$x = c_1e^{-y} + c_2$ (b)$x = c_1e^{y} + c_2$
(c)$x = c_1e^{-y} + c_2y$ (d)$y = c_1e^{x} + c_2$
[JAM CA-2011]
Ans.(a)

175. The orthogonal trajectories of the family of curves $y = c_1x^3$ are, **JAM(MA)-2015**

A) $2x^2 + 3y^2 = c_2$ B) $3x^2 + y^2 = c_2$ C) $3x^2 + 2y^2 = c_2$ D) $x^2 + 3y^2 = c_2$.
Ans. D)

176. The orthogonal trajectories to the family of curve $f(x, y, \frac{dy}{dx}) = 0$ is given by, **WBPSC -15**

A) $f(x, y, \frac{dy}{dx}) = 0$ B) $f(x, y, -\frac{dy}{dx}) = 0$ C) $f(x, y, -\frac{dx}{dy}) = 0$ D) $f(x, -y, \frac{dy}{dx}) = 0$.
Ans. C)

177. The orthogonal trajectories to the family of curve $xy = c$ is given by, **IAS(Prel.)-94**
A) $x^2 - y^2 = c$ B) $x^2 + 2y^2 = c$ C) $x^2 + y^2 = c$ D) $x^2 = cy^2$.
Ans. A)

178. If k is the parameter, then the orthogonal trajectories to the family of cardioia $r = k(1-\cos\theta)$ is given by, **IAS(Prel.)-2000**

A) $r = c(1 + \cos\theta)$ B) $r = c(1 - \cos\theta)$ C) $r(1 + \cos\theta) = c$ D) $r(1 + \sin\theta) = c$.
Ans. A)

179. The orthogonal trajectories to the family of the parabolas $y^2 = 4a(x + a)$ a being parameter is given by the system of curves, **IAS(Prel.)-01**
A) $y^2 = 4a(x + a)$ B) $y^2 = 4a(x - a)$ C) $y^2 = 4ax$ D) $x^2 = 4ay$.
Ans. A)

180. The equation whose solution is self orthogonal is
(a)$p - \frac{1}{p} = p^2$ (b)$(px + y)(x + py) - \lambda p = 0$
(c)$(px - y)(x - py) - \lambda p = 0$ (d)$(px + y)(x - py) - \lambda p = 0$
[IAS(Prel.) -99]
Ans. (d)

181. The general solution of the differential equation $y' = 2^{x-y}$ is
(a)$2^{-x} + 2^{-y} = c$ (b)$2^{-x} - 2^{-y} = c$
(c)$2^x + 2^y = c$ (d)$2^x - 2^y = c$
[JAM CA-2009]
Ans.(d)

182. The differential equation representing all circles centrad at (1, 0) is
(a) $x+y\frac{dy}{dx} = 1$ (b) $x-y\frac{dy}{dx} = 1$ (c) $y-x\frac{dy}{dx} = 1$ (d) $y+x\frac{dy}{dx} = 1$ [JAM CA-2010]
Ans. (a)

183. Consider the system of ODE $\frac{dY}{dx} = AY,\ Y(0) = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ where $A = \begin{pmatrix} 1 & 2 \\ 0 & -1 \end{pmatrix}$ and $Y(x) = \begin{pmatrix} y_1(x) \\ y_2(x) \end{pmatrix}$
(a) $y_1(x) \to \infty$ and $y_2(x) \to 0$ as $x \to \infty$ (b) $y_1(x) \to 0$ and $y_2(x) \to 0$ as $x \to \infty$
(c) $y_1(x) \to \infty$ and $y_2(x) \to -\infty$ as $x \to -\infty$ (d) $y_1(x) \to \infty$ and $y_2(x) \to -\infty$ as $x \to -\infty$
Ans. (a) and (c). **NET(MS): (June)2012**

184. Let $Y(x) = \begin{pmatrix} y_1(x) \\ y_2(x) \end{pmatrix}$ satisfy $\frac{dY}{dx} = AY,\ t > 0,\ Y(0) = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ where A is a 2×2 constant matrix with real entries satisfying $trace\, A = 0$ and $det\, A > 0$. Then $y_1(x)$ and $y_2(x)$ both are
(a) monotonically decreasing functions of t. (b) monotonically increasing functions of t.
(c) oscillating functions of t. (d) constant functions of t.
Ans. (c). **NET(MS): (Dec.)2012**

185. Consider the system of ODE in $\Re^2$, $\frac{dY}{dt} = AY,\ Y(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix},\ t > 0$ where $A = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix}$ and
$Y(t) = \begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix}$. Then **NET(MS): (Dec.)2015**
(a) $y_1(t)$ and $y_2(t)$ are monotonically increasing for $t > 0$.
(b) $y_1(t)$ and $y_2(t)$ are monotonically increasing for $t > 1$.
(c) $y_1(t)$ and $y_2(t)$ are monotonically decreasing for $t > 0$.
(d) $y_1(t)$ and $y_2(t)$ are monotonically decreasing for $t > 1$.
Ans. (d).

186. The critical point of the system $\frac{dx}{dt} = -4x - y,\ \frac{dy}{dt} = x - 2y$ is an **NET(MS): (June)2015**
(a) asymptotically stable node (b) unstable node
(c) asymptotically stable spiral (d) unstable spiral.
Ans. (a).
Hint. The eigenvalues are $-3, -3$. So the eigenvalues are real and negatives. Hence the critical points of the system is an asymptotically stable node.

187. Let $\frac{d^2y}{dx^2} - q(x) = 0,\ 0 \leq x < \infty$ with $y(0) = y'(0) = 0$, where $q(x)$ is positive monotonically increasing continuous function. Then, **NET(MS): (Dec.)2011**
(a) $y(x) \to \infty$ as $x \to \infty$ (b) $y'(x) \to \infty$ as $x \to \infty$
(c) $y(x)$ has finitely many zeros in $[0, \infty)$ (d) $y(x)$ has infinitely many zeros in $[0, \infty)$
Ans. (a) and (b).

188. Test the stability of the system $\dot{x} = y + \frac{xy}{1+t^2},\ \ \dot{y} = -x - y + \frac{y^2}{1+t^2}$
(A) Stable (B) Asymptotically stable (C) Unstable (D) Quasi stable
Ans. (A), (B) and (D)

189. The Fourier sine transform of the function f defined by $\frac{e^{-\alpha x}}{x}$ is
(a) $F_s(s) = \tan^{-1}\frac{s}{\alpha} + k$ (b) $F_s(s) = \cot^{-1}\frac{s}{\alpha} + k$ (c) $F_s(s) = \sin^{-1}\frac{s}{\alpha} + k$ (d) $F_s(s) = \cos^{-1}\frac{s}{\alpha} + k$
Ans. (a) $F_s(s) = \tan^{-1}\frac{s}{\alpha} + k$.

190. Given that $F(S)$ is the one side Laplace transformation of $f(t)$, then Laplace transformation of $L\left\{\int_0^t f(\tau)d\tau\right\}$ is equals to **GATE(CE)-2009**
(A) $sF(s) - f(0)$ (B) $\frac{1}{s}F(s)$ (C) $\int_0^s f(\tau)d\tau$ (D) $\frac{1}{s}F(s) - f(0)$
Ans. (B)

191. If Laplace transformation of $f(t) = \frac{1-e^t}{t}$ is equals to
(A) $\log\left(\frac{s-1}{s}\right)$ (B) $\log\left(\frac{s+1}{s}\right)$ (C) $\log\left(\frac{s}{s-1}\right)$ (D) $\log\left(\frac{s}{s+1}\right)$
Ans. (A)

Hint.
$$\begin{aligned} L\left\{1 - e^t\right\} &= L\left\{1\right\} - L\left\{e^t\right\} = \frac{1}{s} - \frac{1}{s-1} = F(s) \text{ (say)} \\ L\left\{\frac{1-e^t}{t}\right\} &= \int_0^s F(s)ds \\ &= \int_0^s \left(\frac{1}{s} - \frac{1}{s-1}\right)ds = \log\left(\frac{s-1}{s}\right) \end{aligned}$$

192. If Laplace transformation of $L\left\{\int_0^t \frac{\sin t}{t}\right\}$ is equals to
(A $\frac{1}{s}\left(\frac{\pi}{2} - \tan^{-1}s\right)$ (B)$\frac{1}{s}\left(\frac{\pi}{2} + \tan^{-1}s\right)$ (C) $\left(\frac{\pi}{2} - \tan^{-1}s\right)$ (D) $\frac{1}{s}\left(\frac{\pi}{2} - \cot^{-1}s\right)$
Ans. (A)
Hint. Since
$$\begin{aligned} L\left\{\sin t\right\} &= \frac{1}{s^2+1} \\ L\left\{\frac{\sin t}{t}\right\} &= \int_s^\infty \frac{1}{s^2+1}ds = \frac{\pi}{2} + \tan^{-1}s = F(s) \text{ (say)} \\ L\left\{\int_0^t \frac{\sin t}{t}\right\} &= \frac{F(s)}{s} = \frac{1}{s}\left(\frac{\pi}{2} - \tan^{-1}s\right) \end{aligned}$$

193. If $L\left\{J_0(t)\right\} = \frac{1}{\sqrt{s^2+1}}$, then $L\left\{J_0(5t)\right\}$ is equals to
(A $\frac{1}{\sqrt{s^2+25}}$ (B) $\frac{5}{\sqrt{s^2+25}}$ (C) $\frac{1}{\sqrt{s^2-25}}$ (D)$\frac{s}{\sqrt{s^2+25}}$

Ans. (A)
Hint. If $L\Big\{f(t)\Big\} = F(s)$, then

$$\begin{aligned} L\Big\{f(at)\Big\} &= \frac{1}{s}F\Big\{\frac{s}{a}\Big\} \\ L\Big\{J_0(5t)\Big\} &= \frac{1}{5}F\Big\{\frac{s}{5}\Big\} = \frac{1}{\sqrt{s^2+25}} \end{aligned}$$

194. Laplace transformation of f(t) , where

$$f(t) = \begin{cases} t-1, \ 1 < t < 2 \\ 3-t, 2 < t < 3 \end{cases}$$

is equals to
(A) $e^{-s}\frac{1}{s^2} - 2e^{-2s}\frac{1}{s^2} + e^{-3s}\frac{1}{s^2}$ (B) $e^{-s}\frac{1}{s^2} + 2e^{-2s}\frac{1}{s^2} + e^{-3s}\frac{1}{s^2}$
(C) $e^{-s}\frac{1}{s^2} - 2e^{-2s}\frac{1}{s^2} - e^{-3s}\frac{1}{s^2}$ (D) $e^{-s}\frac{1}{s^2} - 2e^{2s}\frac{1}{s^2} + e^{3s}\frac{1}{s^2}$
Ans. (A) Since

$$\begin{aligned} L\Big\{f(t)\Big\} &= (t-1)\Big\{u(t-1) - u(t-2)\Big\} + (3-t)\Big\{u(t-2) + u(t-3)\Big\} \\ &= (t-1)\Big\{u(t-1)\Big\} - 2(t-2)\Big\{u(t-2)\Big\} + (t-3)\Big\{u(t-3)\Big\} \\ &= e^{-s}\frac{1}{s^2} - 2e^{-2s}\frac{1}{s^2} + e^{-3s}\frac{1}{s^2} \end{aligned}$$

195. The Laplace transformation of $(t^2-2t)u(t-1)$ is **GATE(EE)-98**
(A) $\frac{2e^{-s}}{s^3} - \frac{2e^{-s}}{s^2}$ (B) $\frac{2e^{-2s}}{s^3} - \frac{2e^{-s}}{s^2}$
(C) $\frac{2e^{-s}}{s^3} + \frac{2e^{-s}}{s^2}$ (D) $\frac{2e^{-2s}}{s^3} - \frac{e^{-s}}{s}$
Ans. (D)
Hint. Since $L\Big\{f(t-a)u(t-a)\Big\} = e^{-as}F(s)$. Therefore

$$\begin{aligned} L\Big\{(t^2-2t)u(t-a)\Big\} &= L\Big\{\Big((t-1)^2 - 1\Big)u(t-a)\Big\} \\ &= L\Big\{\Big((t-1)^2\Big)u(t-a)\Big\} - L\Big\{u(t-a)\Big\} = e^{-s}\frac{2}{s^3} - \frac{e^{-s}}{s} \end{aligned}$$

196. Consider the function $\frac{5}{s(s^2+3S+2)}$, where $F(s)$ is the Laplace transformation of the function f the initial value of $f(t)$ is equals to **GATE(EE)-04**
(A) 5 (B) $\frac{5}{2}$ (C) $\frac{5}{3}$ (D) 0
Ans. (B)
Hint. By applying initial value theorem

$$\lim_{t\to 0} f(t) = \lim_{s\to\infty} sF(s) = s\Big(\frac{5}{s(s^2+3S+2)}\Big) = \frac{5}{2}$$

197. If Laplace transformation of $f(t)$ is $\frac{5}{s} + \frac{2s}{s^2+9}$, Then $f(0)$ is equals to
(A) 5 (B) 7 (C) 0 (D) ∞
Ans. (B)
Hint. By applying initial value theorem

$$\lim_{t\to 0} f(t) = \lim_{s\to\infty} sF(s) = s\left(\frac{5}{s} + \frac{2s}{s^2+9}\right) = 5 + 2 = 7$$

198. If Laplace transformation of $f(t)$ is $F(s) = \frac{2}{s(s+1)}$. Then $f(\infty)$ is equals to
A) 0 (B) 2 (C) 1 (D) $\propto$ **GATE(ECE)-03**
Ans. (B)
Hint. By applying final value theorem

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s) = \lim_{s\to 0} s\left(\frac{2}{s(s+1)}\right) = 2$$

199. If $F(s) = \frac{2(s+1)}{s^2+4s+7}$. Then the initial and final values of $f(t)$ are respectively **GATE(ECE)-11**
(A) $0, 2$ (B) $2, 0$ (C) $0, 2/7$ (D) $2/7, 0$
Ans. (B)
Hint. By applying initial value theorem

$$\lim_{t\to 0} f(t) = \lim_{s\to\infty} sF(s) = \lim_{s\to\infty} s\left(\frac{2(s+1)}{s^2+4s+7}\right) = 2$$

By applying final value theorem

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s) = \lim_{s\to 0} s\left(\frac{2(s+1)}{s^2+4s+7}\right) = 0$$

200. If $L[f(t)] = \frac{k}{(s+1)(s^2+4)}$. If $\lim_{t\to\infty} f(t) = 1$ is given by **ECE-1993**
(A) $\frac{k}{4}$ (B) zero (C) $0 < k < 12$ (D) $5 < k < 12$
Ans. (B)
Hint. By applying final value theorem

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s) \Rightarrow \lim_{s\to 0} s\left(\frac{k}{(s+1)(s^2+4)}\right) = 1 \Rightarrow k = 0.$$

201. The Laplace transformation of $f(t)$ is given by $F(s) = \frac{2}{s(s+1)}$. As $t \longrightarrow \infty$, the value of $f(t)$ tends to **ECE-2003**
(A) 0 (B) 1 (C) 2 (D) ∞
Ans. (C)
Hint. By applying final value theorem

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s) = \lim_{s\to 0} s\left(\frac{2}{s(s+1)}\right) = 2$$

202. Use Laplace transformation the value of $\int_0^\infty te^{-2t}\sin t dt$ is
A) $\frac{1}{25}$ B) $\frac{2}{25}$ C) $\frac{3}{25}$ D) $\frac{4}{25}$
Ans. (D)
Hint. Since $L\{\sin t\} = \frac{1}{s^2+1}$ and $L\{t\sin t\} = -\frac{d}{ds}\left(\frac{1}{s^2+1}\right) = \frac{2s}{(s^2+1)^2} = \overline{f}(s)$. Now from the definition of Laplace transformation

$$\int_0^\infty e^{-st}f(t)dt = \overline{f}(s) \Rightarrow \int_0^\infty t\sin te^{-2t}dt = \overline{f}(2) = \frac{2\times 2}{(2^2+1)^2} = \frac{4}{25}$$

203. Let y be the solution of the initial value problem

$$\frac{d^2y}{dx^2} + y = 6\cos 2x, \quad y(0) = 3, \quad y^{'} = 1$$

Let the Laplace transformation of y be $F(s)$. Then the value of $F(1)$ is **GATE(MA)-11**
A) $\frac{17}{5}$ B) $\frac{13}{5}$ C) $\frac{11}{5}$ D) $\frac{9}{5}$
Ans. B)
Hint. $F(s) = \frac{6s}{(s^2+1)(s^2+4)} + \frac{3s+1}{s^2+1}$

204. If $Y(s)$ is the Laplace transform of $y(t)$ which is the solution of the initial value problem

$$\frac{d^2y}{dx^2} + y(t) = \begin{cases} 0, & 0 < t < 2\pi \\ \sin t, & t > 2\pi \end{cases}$$

, with $y(0) = 1$ and $y^{'}(0) = 0$, then $Y(s)$ equals **GATE(MA)-04**
A) $\frac{s}{1+s^2} + \frac{e^{-2\pi s}}{(1+s^2)^{\frac{3}{2}}}$ B) $\frac{s+1}{1+s^2}$ C) $\frac{s}{1+s^2} + \frac{e^{-2\pi s}}{(1+s^2)}$ D) $\frac{s(1+s^2)+1}{(1+s^2)^2}$
Ans. A)
Hint.

$$\frac{d^2y}{dx^2} + y(t) = \begin{cases} 0, & 0 < t < 2\pi \\ \sin t, & t > 2\pi \end{cases}$$

Taking Laplace in both sides

$$p^2y(s) - sy(0) - y^{'}(0) + y(s) = \int_{2\pi}^\infty e^{-pt}\sin t dt$$
$$\Rightarrow (s^2+1)y(s) - s = 0 - \frac{e^{-2\pi s}}{\sqrt{1+s^2}}(0-1) \Rightarrow y(s) = \frac{s}{1+s^2} + \frac{e^{-2\pi s}}{(1+s^2)^{\frac{3}{2}}}$$

205. Given that the Laplace transform, $L\left\{e^{at}\right\} = \frac{1}{s-a}$, then $L\left\{3e^{5t}\sin 5t\right\} =$
A) $\frac{3s}{s^2-10}$ A) $\frac{15}{s^2-10s}$ C) $\frac{3s}{s^2+10s}$ D) $\frac{15}{(s-5)^2+25}$ **GATE(AE)-2013**
Ans.(D)

Hint. $L\left\{\sin 5t\right\} = \frac{5}{s^2+25}$ so $L\left\{3e^{5t}\sin 5t\right\} = 3\times\frac{5}{(s-5)^2+25} = \frac{15}{(s-5)^2+25}$

206. The inverse transformation of $\frac{2s^2-4}{(s-3)(s^2-s-2)}$. **GATE(MA)-14**
A) $(1+t)e^{-t}+\frac{7}{2}e^{-3t}$ B) $\frac{e^t}{3}+te^{-t}+2t$ C) $\frac{7}{2}e^{3t}-\frac{e^{-t}}{6}-\frac{4}{3}e^{2t}$ D) $\frac{7}{2}e^{-3t}-\frac{e^{-t}}{6}-\frac{4}{3}e^{-2t}$
Ans. (C)

207. If $F(s)=\tan^{-1}(s)+k$ is the Laplace transform of some function f on $t \geqslant 0$, then $k =$ **GATE(MA)-07**
A) π B) $-\frac{\pi}{2}$ C) 0 D) $\frac{\pi}{2}$
Ans. B)
Hint. $L(f(t))=\tan^{-1}(s)+k \Rightarrow f(t)=L^{-1}(\tan^{-1}(s)+k)=-\frac{\sin t}{t}$
$\Rightarrow L\{-\frac{1}{t}\sin t\}=\tan^{-1}s-\frac{\pi}{2}$

208. Given two continuous time signals $x(t)=e^{-t}$ and $y(t)=e^{-2t}$, which exist for $t>0$, the convolution $z(t)=x(t)\star y(t)$ is **GATE(EE)-11**
A) $e^{-t}-e^{-2t}$ B) e^{-3t} C) e^{-t} D) $e^{-t}+e^{-2t}$
Ans. (A) Taking Laplace transformation, we get

$$L\Big\{z(t)\Big\}=L\Big\{x(t)\star y(t)\Big\} \Rightarrow Z(s)=X(s)\cdot Y(s)=\frac{1}{s+1}\cdot\frac{1}{s+2}$$
$$\Rightarrow L^{-1}\Big\{Z(s)\Big\}=L^{-1}\Big\{\frac{1}{s+1}\cdot\frac{1}{s+2}\Big\}$$
$$\Rightarrow z(t)=L^{-1}\Big\{\frac{1}{s+1}-\frac{1}{s+2}\Big\}=L^{-1}\Big\{\frac{1}{s+1}\Big\}-L^{-1}\Big\{\frac{1}{s+2}\Big\}=e^{-t}-e^{-2t}$$

209. Consider the Laplace equation in polar form :
$\frac{\partial^2 u}{\partial r^2}+\frac{1}{r}\frac{\partial u}{\partial r}+\frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2}=0,\ 0<r<a,\ 0\le\theta<2\pi$ subject to the condition $u(a,\theta)=f(\theta)$, where f is the given function. Let σ be the separation constant that appears when one uses the method of separation of variables. Then for solution $u(r,\theta)$ to be bounded and also periodic in $\theta$with period 2π, **NET(MS): (June)2013**
(a) σ can not negative, (b) σ can be zero and in that case the solution is a constant
(c)σ can be positive and in that case the solution must be an integer (d) the fundamental set of solutions is $\{1, r^n\sin n\theta, r^n\cos n\theta\}$, where n is a positive integer.
Ans. (a), (b), (c) (d). (Note: All answers are correct.)

210. The differential equation
$\frac{\partial^2 u}{\partial x^2}=\frac{\partial u}{\partial t}, u=u(x,t),\ 0<x<\pi,\ t>0$ with $u(0,t)=0=u(\pi,t),\ t>0$
$u(x,0)=\sin x+\sin 2x,\ 0\le x\le\pi$. Then
(a) $u(x,t)\to 0$ as $t\to 0$ for all $x\in(0,\pi)$
(b) $t^2u(x,t)\to 0$ as $t\to 0$ for all $x\in(0,\pi)$
(c) $e^1u(x,t)$ is a bounded function for $x\in(0,\pi),\ t>0$
(d)$e^2(x,t)\to 0$ as $t\to 0$ for all $x\in(0,\pi)$ **NET(MS): (June)2012**
Ans. (a), (b), (c).

211. The solution of the ODE $\frac{d^2y}{dx^2}+y=0,\ x>0$ with $y(0)=1,\ y'(0)=0$ is equivalent to the Volterra integral equation **NET(MS): (Dec.)2012**
where (a) $y(x)=1+\int_0^x(t-x)y(t)dt$ (b) $y(x)=1+\int_0^x(t+x)y(t)dt$
(c) $y(x)=1+\int_0^x xty(t)dt$ (d) $y(x)=1+\int_0^x(x-t)y(t)dt$
Ans. (a).

212. Let $y(x)$ be a continuous solution of the initial value problem $y' + 2y = f(x)$, $y(0) = 0$, where

$$
\begin{aligned}
f(x) &= 1,\ 0 \le x \le 1 \\
&= 0,\ x > 1
\end{aligned}
$$

. Then $y(\frac{2}{3})$ is equal to **NET(MS): (June)2015**
(a) $\frac{\sinh(1)}{e^3}$ (b) $\frac{\cosh(1)}{e^3}$ (c) $\frac{\sinh(1)}{e^2}$ (d) $\frac{\cosh(1)}{e^2}$.
Ans. (c).

213. Let y be the solution of initial value problem

$$\frac{d^2y}{dx^2} + y = 6\cos 2x \tag{1.-70}$$

Given that $y(0) = 3$ and $y^{'}(0) = 1$. Let the Laplace Transform of y be $F(s)$. Then the value of $F(1)$ is equals to **GATE(MA)-2011**
(A) $\frac{17}{5}$ (B) $\frac{13}{5}$ (C) $\frac{11}{5}$ d (D) $\frac{9}{5}$
Ans. (B)
Hint. Applying Laplace transform in both sides with respect to t in the equation $(1.-70)$, we obtain $\{s^2F(s) - sy(0) - y'(0)\} + F(s) = \frac{6s}{s^2+4}$. Using the initial conditions, we get, $s^2F(s) - 3s - 1 + F(s) = \frac{6s}{s^2+4}$, $(s^2 + 1)F(s) = 3s + 1 + \frac{6s}{s^2+4}$. Therefore, $F(1) = \frac{13}{5}$.

214. The inverse Laplace Transform of $\frac{s^2}{(s-3)^3}$ can be written as $\frac{e^{3t}}{2}[At^2 + Bt + C]$. The values of A, B and C, respectively are **GATE(AE)-11**
(A) $3, 5$ and 7 (B) $2, 10$ and 12 (C) $10, 12$ and 4 (D) $9, 12$ and 2.
Ans. (D)
Hence, $L\{\frac{e^{3t}}{2}[At^2 + Bt + C]\} = \frac{A}{(s-3)^3} + \frac{B}{2(s-3)^2} + \frac{C}{2(s-3)}$

215. The Green function G in x, t of the boundary value problem $\frac{d^2y}{dx^2} - \frac{1}{x}\frac{dy}{dx} = 1$ with $y(0) = y(1) = 0$ is

$$
\begin{aligned}
G(x,t) &= f_1(x,t),\ x \le t \\
&= f_2(x,t),\ t \le x
\end{aligned}
$$

where **NET(MS): (Dec.)2011**
(a) $f_1(x,t) = -\frac{1}{2}t(1-x^2)$, $f_2(x,t) = -\frac{1}{2t}x^2(1-t^2)$
(b) $f_1(x,t) = -\frac{1}{2x}t^2(1-x^2)$, $f_2(x,t) = -\frac{1}{2t}x^2(1-t^2)$
(c) $f_1(x,t) = -\frac{1}{2t}x^2(1-t^2)$, $f_2(x,t) = -\frac{1}{2t}t(1-x^2)$
(d) $f_1(x,t) = -\frac{1}{2t}x^2(1-t^2)$, $f_2(x,t) = -\frac{1}{2t}t^2(1-x^2)$.
Ans. (a) and (c).

216. If $f(t) = L^{-1}\left[\frac{3s+1}{s^3+4s^2+(k-3)s}\right]$. If $\lim_{t\to 0} f(t) = 1$. Then value of k is **ECE-2010**
(A) 1 (B) 2 (C) 3 (D) 4
Ans. (B)

Hint. By applying final value theorem

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s) \qquad \Rightarrow \lim_{s\to 0} s\left(\frac{3s+1}{s^3+4s^2+(k-3)s}\right) = 1$$

$$\text{or} \qquad \frac{1}{k-3} = 1 \qquad \Rightarrow k = 2$$

217. The boundary value problem $\frac{d^2y}{dx^2} = f(x)$, $x \in (0,1)$ with $y(0) = y(1) = 0$ is given by $y(x) = \int_0^1 G(x,\xi)f(\xi)d\xi$ **NET(MS): (Dec.)2012**

where $(a)\ G(x,\xi) = x(\xi-1),\ x \le \xi$; $= \xi(x-1),\ x > \xi$ $\quad (b)\ G(x,\xi) = x^2(\xi-1),\ x \le \xi$; $= \xi^2(x-1),\ x > \xi$

$(c)\ G(x,\xi) = x(\xi^2-1),\ x \le \xi$; $= \xi(x^2-1),\ x > \xi$ $\quad (d)\ G(x,\xi) = \sin x(\xi-1),\ x \le \xi$; $= \sin \xi(x-1),\ x > \xi$ **Ans.** (a).

218. The solution of the initial value problem

$$y'' + 2y' + 10y = 6\delta(t), \quad y(0) = y'(0) = 0$$

Where $\delta(t)$ denotes the Dirac-delta function , is
(a) $2e^t \sin 3t$, (b) $6e^t \sin 3t$ (c) $2e^{-t} \sin 3t$, (d) $6e^{-t} \sin 3t$. **GATE(MA)-12**
Ans. (c).

219. Let $y(t)$ be the continuous function on $[0, \infty)$ whose Laplace Transform exists. If $y(t)$ satisfies

$$\int_0^t (1-\cos(t-u))y(u)du = t^4,$$

then $y(1)$ is equal to
(A) 20 (B) 24 (C) 28 (D) 30 **GATE(MA)-15**
Ans. (C)
Hint. Using convolution Theorem, we get, $L\{1-\cos t\}\cdot L\{y(t)\} = L\{t^4\} \Rightarrow (\frac{1}{s} - \frac{s}{s^2+1})Y(s) = \frac{24}{s^5}$. Using inverse Laplace transform, we get, $y(t) = 24t + 4t^3$.

220. Let $y(t)$ be the continuous function on $[0, \infty)$ if $y(t) = t(1 - 4\int_0^t y(x)dx) + 4\int_0^t xy(x)dx$, then $\int_0^{\frac{\pi}{2}} y(t)dt$ is equal to **GATE(MA)-16**
Ans. $\frac{1}{2}$.
Hint. Using Laplace Transformation, we get, $Y(s) = \frac{1}{s^2} + 4\frac{d}{ds}\left(\frac{Y(s)}{s}\right) + 4\frac{L\{ty(t)\}}{s} = \frac{1}{s^2} + 4\frac{Y'(s)}{s} - 4\frac{Y(s)}{s^2} - 4\frac{Y'(s)}{s} \Rightarrow Y(s) = \frac{1}{2}\cdot\frac{2}{s^2+4}$. Using inverse Laplace transform, we get, $y(t) = \frac{\sin 2t}{2}$.

221. The solution of the integral equation $y(x) = x + \int_0^x \sin(x-t)y(t)dt$, is **GATE(MA)-13**
(A) $x^2 + \frac{x^3}{3}$ (B) $x - \frac{x^3}{3!}$ (C) $x + \frac{x^3}{3!}$ (D) $x^2 + \frac{x^3}{3!}$.
Ans. (C)

222. Consider the integral equation $y(x) = x^3 + \int\limits_0^x \sin(x-t)y(t)dt$, $x \in [0, \pi]$. Then the value of $y(1)$ is **NET(JUNE)-16**
(A) $\frac{19}{20}$ (B) 1 (C) $\frac{17}{20}$ (D) $\frac{21}{20}$.
Ans. (D)

223. Let $y_1(x)$ and $y_2(x)$ be solutions of

$$x^2y'' + y' + (\sin x)y = 0$$

which satisfy the boundary conditions $y_1(0) = 0$, $y_1'(1) = 1$ and $y_2(0) = 1$, $y_2'(1) = 0$ respectively. Then, **GATE(MA)-03**
A) y_1 and y_2 do not have common zeros B) y_1 and y_2 have common zeros
C) either y_1 or y_2 has a zero of order 2 D) both y_1 and y_2 have zeros of order 2
Ans. B)

224. The initial value problem

$$x\frac{d^2y}{dx^2} + \frac{dy}{dx} + xy = 0,\ y(0) = 1,\ \left(\frac{dy}{dx}\right)_{x=0} = 0$$

has **GATE(MA)-06**

A) a unique solution B) no solution
C) infinitely many solution D) two linearly independent solutions.
Ans. B)

225. Consider the following statement P and Q: **GATE(MA)-2016**
(P) : $x^2y'' + xy' + (x^2 - \frac{1}{4})y = 0$ has two linearly independent Frobenius series solution near $x = 0$.
(Q) : $x^2y'' + 3\sin xy' + y = 0$ has two linearly independent Frobenius series solution near $x = 0$.
which of the following statements hold TRUE?
(A) both P and Q (B) only P (C) only Q (D) Neither P nor Q.
Ans. (A).

226. If $\sum\limits_{m=0}^{\infty} c_m x^{r+m}$ is assumed to be a solution of

$$x^2y'' - xy' - 3(1 + x^2)y = 0$$

then the values of r are **GATE(MA)-12**
A) $1, 3$ B) $-1, 3$ C) $1, -3$ D) $-1, -3$
Ans. B)

227. For the differential equation

$$(x-1)y'' + (\cot \pi x)y' + (cosec^2 \pi x)y = 0,$$

which of the following statement is true **GATE(MA)-06**
(A) 0 is regular and 1 is irregular (B) 0 is regular and 1 is regular
(C) Both 0 and 1 are regular (D) Both 0 and 1 are irregular
Ans. A)

228. The initial value problem $xy'' + y' + xy = 0,\ y(0) = 0,\ (\frac{\partial y}{\partial x})_{x=0} = 0$ has **GATE(MA)-06**
(A) Unique solution (B) No solution
(C) Infinite number of Solution (D) Two independent solutions
Ans. B)

229. For the differential equation **GATE(MA)-05**

$$x^2(1-x)\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$$

A) $x = 1$ is an ordinary point. B) $x = 1$ is a regular singular point.
C) $x = 0$ is an irregular singular point. D) $x = 0$ is an ordinary point.
Ans. B)

230. It is required to find the solution of differential equation

$$2x(2x+3)y^{''} + 2(3+x)y^{'} - xy = 0$$

around $x = 0$. The roots of the indicial equation are **GATE(MA)-05**
A) $0, \frac{1}{2}$ B) $0, 2$ C) $\frac{1}{2}, \frac{1}{2}$ D) $0, -\frac{1}{2}$
Ans. D)

231. It is required to find the solution of differential equation

$$2x(2+x)y^{''} - 2(3+x)y^{'} + xy = 0$$

around $x = 0$. The roots of the indicial equation are **GATE(MA)-05**
A) $0, \frac{1}{2}$ B) $0, 2$ C) $\frac{1}{2}, \frac{1}{2}$ D) $0, -\frac{1}{2}$
Ans. B)

232. The indicial equation for

$$x(1+x^2)y^{''} + (\cos x)y^{'} + (1-3x+x^2)y = 0 \qquad \text{is}$$

A) $r^2 - r = 0$ B) $r^2 + r = 0$ C) $r^2 = 0$ D) $r^2 - 1 = 0$ **GATE(MA)-04**
Ans. C)

233. For

$$x(x-1)y^{''} + (\sin x)y^{'} + 2x(x-1)y = 0$$

consider the following statements
P: $x = 0$ is a regular singular point.
Q: $x = 1$ is a regular singular point. **GATE(MA)-08**
A) both P and Q are true. B) P is false and Q is true.
C) P is true and Q is false. D) both P and Q are false.
Ans. B)
Hint. $\frac{\sin x}{x} \to 0$ as $x \to 0$. So $x = 0$ is a ordinary point.

234. Suppose the equation

$$x^2y^{''} - xy^{'} + (1+x^2)y = 0$$

has a solution of the form $y = \sum_{n=0}^{\infty} c_n x^{n+r}$. **GATE(MA)-07**
i) The indicial equation for r is

A) $r^2 - 1 = 0$ B) $(r-1)^2 = 0$ C) $(r+1)^2 = 0$ D) $r^2 + 1 = 0$
Ans. B)
ii) For $n \geq 2$ the co-efficient of c_n will be satisfy the relation
A) $n^2 c_n - c_{n-2} = 0$ B) $n^2 c_n + c_{n-2} = 0$
C) $c_n - c_{n-2} = 0$ D) $c_n + c_{n-2} = 0$
Ans. B)

235. If $y = \sum\limits_{m=0}^{\infty} a_m x^m$ is a solution of $y'' + xy' + 3y = 0$ then $\frac{a_m}{a_{m+2}}$. **GATE(MA)-04**
A) $\frac{(m+1)(m+2)}{m+3}$ B) $-\frac{(m+1)(m+2)}{m+3}$ C) $-\frac{m(m-1)}{m+3}$ D) $\frac{m(m-1)}{m+3}$
Ans. B)

236. Let $P_n(x)$ be the Legedre polynomial of degree n and $I = \int_{-1}^{1} x^k P_n(x)dx$, where k is the non-negative integer. Consider the following statements P and Q : **GATE(MA)-2016**
(P) : $I = 0$ if $k < n$.
(Q) : $I = 0$ if $n - k$ is an odd integer.
which of the following statements hold TRUE?
(A) both P and Q (B) only P (C) only Q (D) Neither P nor Q.
Ans. (A).
Hint. We have $x^k = \sum\limits_{m=0}^{k} C_m P_m(x)$ where C_m are real constants. Also $\int_{-1}^{1} P_m(x)P_n(x)dx = 0$ if $m \neq n$. Hence the result.

237. Let the Legedre equation

$$(1-x^2)y'' - 2xy' + n(n+1)y = 0$$

have n-th degree polynomial solution $y_n(x)$ such that $y_n(1) = 3$. If $\int_{-1}^{1}(y_n^2(x) + y_{n-1}^2(x))dx = \frac{144}{15}$, then n is **GATE(MA)-12**
A) 1 B) 2 C) 3 D) 4.
Ans. B)

238. Let $P_n(x)$ be the Legendre polynomial of degree n such that $P_n(1) = 1$, $n = 1, 2, \cdots$ if $\int_{-1}^{1}\left(\sum\limits_{j=1}^{n} \sqrt{j(2j+1)}P_j(x)\right)^2 dx = 20$, then $n =$ **GATE(MA)-09**
A) 2 B) 3 C) 4 D) 5.
Ans. C)
Hint. $\int_{-1}^{1}(P_n(x))^2 dx = \frac{2}{2n+1}$

239. Let $P_n(x)$ be the Legendre polynomial of degree n and let

$$P_{m+1}(0) = -\frac{m}{m+1}P_{m-1}(0), \quad m = 1, 2, \ldots$$

If $P_n(0) = -\frac{5}{16}$, then $\int_{-1}^{1} P_n^2(x)dx =$ **GATE(MA)-07**
A) $\frac{2}{13}$ B) $\frac{2}{9}$ C) $\frac{5}{16}$ D) $\frac{2}{5}$.
Ans. A)
Hint. $P_1(0) = 0,\ P_2(0) = -\frac{1}{2}P_0(0) = -\frac{1}{2},\ P_3(0) = -\frac{2}{3}P_1(0) = 0, \cdots, P_6(0) = -\frac{5}{16}$
$\int_{-1}^{1} P_n^2(x)dx = \frac{2}{2n+1} = \frac{2}{13}$

240. The weight function of Legendre polynomial is
(a) $W(x) = 1$ (b) $W(x) = x$ (c) $W(x) = 1 - x$ (d) none of these.
Ans. (a) $W(x) = 1$

241. Let $P_n(x)$ denote the Legendre polynomial of degree n. If

$$f(x) = \begin{cases} x, & -1 \leq x \leq 0 \\ 0, & 0 \leq x \leq 1 \end{cases}$$

and $f(x) = a_0P_0(x) + a_1P_1(x) + a_2P_2(x) + \ldots$ then **GATE(MA)-05**

A) $a_0 = -\frac{1}{4},\ a_1 = -\frac{1}{2}$ B) $a_0 = -\frac{1}{4},\ a_1 = \frac{1}{2}$
C) $a_0 = \frac{1}{2},\ a_1 = -\frac{1}{4}$ D) $a_0 = -\frac{1}{2},\ a_1 = -\frac{1}{4}$.
Ans. B)
Hint. $f(x) = \sum\limits_{r=0}^{\infty} a_rP_r(x),\ a_r = (r + \frac{1}{2}) \int_{-1}^{1} f(x)P_r(x)dx$

242. Let $P_n(x)$ be the Legendre polynomial of degree $n \leq 0$. If $1 + x^{10} = \sum\limits_{n=0}^{10} C_nP_n(x)$, then C_5 is **GATE(MA)-04**

A) 0 B) $\frac{2}{11}$ C) 1 D) $\frac{11}{2}$.
Ans. A)
Hint. As equating the co-efficient of x^5.

243. Let $y = \phi(x)$ and $y = \psi(x)$ be solutions of

$$y^{''} - 2xy^{'} + (\sin x^2)y = 0$$

such that $\phi(0) = 1\ \phi^{'}(0) = 1,\ \psi(0) = 1,\ \psi^{'}(0) = 2$. Then the value of $W(\phi, \psi)$ at $x = 1$ is **GATE(MA)-04**

A) 0 B) 1 C) e D) e^2.
Ans. C)

244. Let$y$ be the polynomial solution of the differential equation

$$(1 - x^2)y^{''} - 2xy^{'} + 6y = 0$$

If $y(1) = 2$, then the value of the integral $\int_{-1}^{1} y^2(x)dx$ is **GATE(MA)-11**
A) $\frac{1}{5}$ B) $\frac{2}{5}$ C) $\frac{4}{5}$ D) $\frac{8}{5}$.
Ans. D)
Hint. $I = y(1)^2 \frac{2}{2n+1}$

245. The interval of x of Legendre polynomial is
(a) $[-1, 1]$ (b) $(-1, 1)$ (c) $[0, 1]$ (d) $[-1, 1)$
Ans. (a) $[-1, 1]$.

246. The Legendre polynomial $P_n(x)$ is
(a) even if n is even (b) odd if n is even (c) even if n is odd (d) none of these.
Ans. (a) even if n is even.

247. The general solution to the differential equation

$$x^2\frac{d^2x}{dy^2}+x\frac{dy}{dx}+\Big(4x^2-\frac{5}{25}\Big)y=0 \text{ is}$$ **GATE(MA) – 2014**

A) $y(x)=\alpha J_{\frac{3}{5}}(2x)+\beta J_{-\frac{3}{5}}(2x)$ B) $y(x)=\alpha J_{\frac{3}{10}}(x)+\beta J_{-\frac{3}{10}}(x)$
C) $y(x)=\alpha J_{\frac{3}{5}}(x)+\beta J_{-\frac{3}{5}}(x)$ D) $y(x)=\alpha J_{\frac{3}{10}}(2x)+\beta J_{-\frac{3}{10}}(2x)$
Ans. (A)

248. It is known that Bessel function $J_n(x)$, $n\geq 0$, satisfy the identity $e^{\frac{x}{2}(t-\frac{1}{t})}=J_0(x)+\sum\limits_{n=1}^{\infty}J_n(x)\Big(t^n+\frac{(-1)^n}{t^n}\Big)$ for all $t>0$, and $x\in\Re$. The value of $J_0(\frac{\pi}{3})+2\sum\limits_{n=1}^{\infty}J_{2n}(\frac{\pi}{3})$ is equal to **GATE(MA)-2015**
(A) 2 (B) 1 (C) 3 (D) 0
Ans. (B)

Hint. We have put $t=1$, we get $1=J_0(x)+2\sum\limits_{n=1}^{\infty}J_{2n}(x)$, $x\in\Re$. Then replacing x by $\frac{\pi}{3}$, we obtain $J_0(\frac{\pi}{3})+2\sum\limits_{n=1}^{\infty}J_{2n}(\frac{\pi}{3})=1$.

249. If $J_n(x)$ and $Y_n(x)$ denote Bessel functions of order n of the first and second kind, then the general solution of the differential equation $x\frac{d^2x}{dy^2}-x\frac{dy}{dx}+xy=0$ is **GATE(MA)-2005**
A) $y(x)=\alpha xJ_1(x)+\beta xY_1(x)$ B) $y(x)=\alpha J_0(x)+\beta Y_0(x)$
C) $y(x)=\alpha J_1(x)+\beta Y_1(x)$ D) $y(x)=\alpha xJ_0(x)+\beta xY_0(x)$
Ans. A)

250. $L_n(x)=\frac{e^x}{(n!)^2}\frac{d^n(x^ne^{-x})}{dx^n}$, for every n positive integer is a
(a) Laguerre polynomial (b) Hermite polynomial (c) Bessel polynomial (d) Legendre polynomial
Ans. (a) Laguerre polynomial.

251. $H_n(x)=(-1)^ne^{x^2}\frac{d^n(e^{-x^2})}{dx^n}$, for every n positive integer is a
(a) Laguerre polynomial (b) Hermite polynomial (c) Bessel polynomial (d) Legendre polynomial
Ans. (b) Hermite polynomial.

Chapter 2

Partial Differential Equations

Example 2.1 1. Heat equation in one-dimension i.e $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ is parabolic type PDE.

2. Poisson's equation i.e $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(x, y)$ is elliptic type PDE.

3. Laplace's equation: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is also elliptic type PDE.

Example 2.2 Form a partial differential equation, eliminate the arbitrary functions ϕ and ψ from $u = \phi(x + ct) + \psi(x - ct)$. [V.U(Hons.)-2013]

Solution : Here the equation is

$$u = \phi(x + ct) + \psi(x - ct) \tag{2.1}$$

Differentiating (2.1) partially *w.r.t.* x, we get, $\frac{\partial u}{\partial x} = \phi^{'}(x + ct) + \psi^{'}(x - ct)$. Again differentiating *w.r.t.* x partially, we get, $\frac{\partial^2 u}{\partial x^2} = \phi^{''}(x + ct) + \psi^{''}(x - ct)$. Now differentiating (2.1) partially *w.r.t.* t, we get, $\frac{\partial u}{\partial t} = c\phi^{'}(x + ct) - c\psi^{'}(x - ct)$. Again differentiating *w.r.t.* t partially, we get, $\frac{\partial^2 u}{\partial t^2} = c^2\{\phi^{''}(x + ct) + \psi^{''}(x - ct)\}$. Therefore, $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ which is the required partial differential equation.

Example 2.3 Form a partial differential equation by eliminating the function ϕ from $lx + my + nu = \phi(x^2 + y^2 + u^2)$ N.B.U(Hons.)-2007

Solution : Here the equation is $lx + my + nu = \phi(x^2 + y^2 + u^2)$. Differentiating the given relation partially w.r.t. x and y separately we get,

$$\begin{aligned}
& l + n\frac{\partial u}{\partial x} = \phi'(x^2 + y^2 + z^2)(2x + 2u\frac{\partial u}{\partial x}) \\
& \Rightarrow\ l + np = \phi'(x^2 + y^2 + u^2)(x + up) && (2.2) \\
& \text{and } m + n\frac{\partial u}{\partial y} = \phi'(x^2 + y^2 + u^2)(2y + 2u\frac{\partial u}{\partial y}) \\
& \Rightarrow\ m + nq = 2\phi'(x^2 + y^2 + u^2)(y + uq) && (2.3)
\end{aligned}$$

Dividing (2.2) and (2.3), we get $\frac{l+np}{m+nq} = \frac{x+up}{y+uq} \Rightarrow y(l + np) + u(lq - mp) = (m + nq)x$ which is the required partial differential equation.

2.0.1 Physical Origin

The following is a situation in physics which is best described by a partial differential equation.

Example 2.4 Form a partial differential equation of all surfaces of revolution having z-axis as the axis of revolution. B.U(Hons.)-2005; I.A.S.-1997

Solution : The equation of any surface of revolution having z-axis as the axis of rotation may be taken as $z = f(\sqrt{x^2 + y^2})$ where f is the arbitrary function. Differentiating $z = f(\sqrt{x^2 + y^2})$ partially *w.r.t.* x and y, we get, $\frac{\partial z}{\partial x} = p = f'(\sqrt{x^2 + y^2})\frac{x}{(\sqrt{x^2+y^2})}$ and $\frac{\partial z}{\partial y} = q = f'(\sqrt{x^2 + y^2})\frac{y}{(\sqrt{x^2+y^2})}$. From above equations, we get $\frac{p}{q} = \frac{x}{y}$ or, $py = xq$ which is the required partial differential equation.

2.0.2 Optimization Origin

We now consider a solution technique of a non-linear optimization problem with constraint which give rise to partial differential equations.

Example 2.5 Let us consider a maximization problem as

$$\begin{aligned}
\text{Maximization} \quad & Z = J(x, y) \\
\text{Subject to} \quad & f(x, y) = 0 && (2.4)
\end{aligned}$$

Solution: For (2.4), to determine optimal z^*, first find Lagrange function $L(x, y, \lambda) = J(x, y) + \lambda f(x, y)$ and then for optimal x^*, y^*, λ^*,

$$\frac{\partial L(x, y, \lambda)}{\partial x} = 0, \quad \frac{\partial L(x, y, \lambda)}{\partial y} = 0 \text{ and } \frac{\partial L(x, y, \lambda)}{\partial \lambda} = 0$$

Definition 2.1 (The Cauchy Initial Value problem) If (i) x_0, y_0 and z_0 are functions of s which together with their first derivatives, are continuous in the interval I defined by $a < s < b$.
(ii) And if f is continuous function of x, y, z, p and q in certain region S of the (x, y, z, p, q)-space, then it is required to establish the existence of a function ϕ of x and y with the following properties:
(a) ϕ and its partial derivatives with respect to x and y are continuous functions of x and y in a region $\Re$ of the (x, y)-plane.
(b) For all values of x and y lying in $\Re$, the point $\{x, y, \phi(x, y), \phi_x(x, y), \phi_y(x, y)\}$ lies in S and $f(x, y, \phi(x, y), \phi_x(x, y), \phi_y(x, y)) = 0$.
(c) For all s belonging to the interval I, the point $(x_0(s), y_0(s))$ belongs to the region $\Re$ and $\phi(x_0(s), y_0(s)) = z_0$.
Stated geometrically, we wish to show that there exists a surface $z = \phi(x, y)$ which passes through the curve which parametric equations are given by

$$x = x_0(s), \qquad y = y_0(s), \qquad z = z_0(s),$$

and at every point of which the direction $(p, q, -1)$ of the normal is such that

$$f(x, y, z, p, q) = 0.$$

Theorem 2.1 (Cauchy's Existence Theorem) If $g(y)$ and all its derivatives are continuous for $|y - y_0| < \delta$ if $z_0 = g(y_0)$, $q_0 = g'(y_0)$ and x_0 be given if $F(x, y, z, q)$ and all its partial derivatives are continuous on a region D defined by $|x - x_0| < \delta$, $|y - y_0| < \delta$, $|q - q_0| < \delta$, then there exists a unique function ϕ such that

1. $\phi(x, y)$ and all its partial derivatives are continuous in a region R defined by $|x - x_0| < \delta_1$, $|y - y_0| < \delta_2$
2. For all $(x, y) \in R$, $z = (x,\ y)$ is a solution of the equation

$$\frac{\partial z}{\partial x} = F\left(x, y, z, \frac{\partial z}{\partial y}\right)$$

3. For all values of y in the interval $|y - y_0| < \delta_1$, $\phi(x_0, y) = g(y)$.

Theorem 2.2 (**The existence and uniqueness theorem for the solution of Cauchy's problem for quasi-linear partial differential equation:)** Let $x_0(s), y_0(s)$ and $z_0(s)$ be continuous differential functions of s in a closed interval, say $[0, 1]$ and P, Q, R be functions of x, y, z having continuous first order partial derivatives with respect to their arguments in some domain D of (x, y, z) - space containing the initial data curve

$$\mathbf{C} : x = x_0(s),\ \ y = y_0(s),\ \ z = z_0(s),\ \ 0 \le s \le 1 \tag{2.5}$$

and satisfying the condition.

$$\frac{dy_0(s)}{ds}P(x_0(s), y_0(s), z_0(s)) - \frac{dx_0(s)}{ds}Q(x_0(s), y_0(s), z_0(s)) \neq 0 \tag{2.6}$$

Then there exists a unique solution $z = z(x, y)$ of the quasi-linear equation

$$P(x, y, z)p + Q(x, y, z)q = R(x, y, z) \tag{2.7}$$

in the neighborhood of the datum curve $\gamma : x = x_0(s),\ y = y_0(s)$ and satisfying the condition

$$z_0(s) = z(x_0(s), y_0(s)), \ \ 0 \leq s \leq 1 \tag{2.8}$$

and the solution is unique.
(Note that the condition mentioned in equation (2.6) excludes the possibility that datum curve γ be a characteristic curve.)

2.0.3 Working rule for solving the PDE Pp+Qq=R by Lagrange's Method

The process of obtaining the solutions of a PDE $Pp + Qq = R$ by Lagrange's Method consists of the following four steps:
Step I: Put the given linear PDE of the first order in the standard form $Pp + Qq = R$
Step II: Write down Lagrange's auxiliary equations $\frac{dx}{P} = \frac{dy}{Q} = \frac{du}{R}$.
Step III: Solve the auxiliary equations, let the two independent solution be $f(x, y, u) = c_1$ and $g(x, y, u) = c_2$
Step IV: The general solution is then written in one of the following three equivalent forms: $\phi(f,\ g) = 0$ or $f = \phi(g)$ or $g = \phi(f)$ where ϕ is an arbitrary function.

Remark: The auxiliary equation $\frac{dx}{P} = \frac{dy}{Q} = \frac{du}{R}$ can be solved by choosing λ, μ, ν may be constants or functions of $x,\ y,\ u$.

Example 2.6 Find two families of surfaces that generate the characteristics of

$$(3y - 2u)p + (u - 3x)q = 2x - y.$$

Solution: The Auxiliary equations

$$\begin{aligned} \frac{dx}{P} &= \frac{dy}{Q} = \frac{du}{R} \\ \Rightarrow \frac{dx}{3y-2u} &= \frac{dy}{u-3x} = \frac{du}{2x-y} \end{aligned}$$

Gives rise

$$\begin{aligned} dx + 2dy + 3du &= 0, \ (\lambda = 1, \mu = 2, \nu = 3) \\ xdx + ydy + udu &= 0, \ (\lambda = x, \mu = y, \nu = u) \end{aligned}$$

Which integrate to two families of surfaces

$$\begin{aligned} x + 2y + 3u &= c_1 \\ x^2 + y^2 + u^2 &= c_2 \end{aligned}$$

Where c_1, c_2 are two arbitrary constants.

Example 2.7 Find the general integral of the following differential equation

$$x^2(y-u)p + y^2(u-x)q = u^2(x-y).$$

Solution: The Auxiliary equations

$$\frac{dx}{P} = \frac{dy}{Q} = \frac{du}{R} \Rightarrow \frac{dx}{x^2(y-u)} = \frac{dy}{y^2(u-x)} = \frac{du}{u^2(x-y)}$$

Gives rise

$$\begin{aligned} \frac{dx}{x^2} + \frac{dy}{y^2} + \frac{du}{u^2} &= 0, \ (\lambda = \frac{1}{x^2}, \mu = \frac{1}{y^2}, \nu = \frac{1}{u^2}) \\ \frac{dx}{x} + \frac{dy}{y} + \frac{du}{u} &= 0, \ (\lambda = \frac{1}{x}, \mu = \frac{1}{y}, \nu = \frac{1}{u}) \end{aligned}$$

Which integrate to two families of surfaces

$$\frac{1}{x} + \frac{1}{y} + \frac{1}{u} = c_1 \text{ and } \log x + \log y + \log u = \log c_2 \Rightarrow xyu = c_2$$

Where c_1, c_2 are two arbitrary constants. Therefore the general integral is $\frac{1}{x} + \frac{1}{y} + \frac{1}{u} = \Phi(xyu)$.

Definition 2.2 (**Compatible systems of first order PDEs**)A given system of two first order PDEs

$$f(x, y, z, p, q) = 0 \tag{2.9}$$

$$\text{and} \qquad g(x, y, z, p, q) = 0 \tag{2.10}$$

are said to be compatible if they have a common solution.

Theorem 2.3 The equations $f(x, y, z, p, q) = 0$ and $g(x, y, z, p, q) = 0$ are compatible on a domain D if
(i) $J = \frac{\partial(f,g)}{\partial(p,q)} \neq 0$ on D,
(ii) p and q can be explicitly solved from (2.9) and (2.10) as $p = \phi(x, y, z)$ and $q = \psi(x, y, z)$. Further, the equation $dz = \phi(x, y, z)dx + \psi(x, y, z)dy$ is integrable.

Theorem 2.4 A necessary and sufficient condition for the integrability of the equation $dz = \phi(x, y, z)dx + \psi(x, y, z)dy$ is

$$[f, g] \equiv \frac{\partial(f, g)}{\partial(x, p)} + p\frac{\partial(f, g)}{\partial(z, p)} + \frac{\partial(f, g)}{\partial(y, q)} + q\frac{\partial(f, g)}{\partial(z, q)} = 0. \tag{2.11}$$

In other words the equations (2.9) and (2.10) are compatible iff (2.11) holds.

2.1 Clairaut's form

A first order PDE is said to be of Clairaut's form if it can be written as $z = px + qy + F(p, q)$. Then the corresponding Charpit's Auxiliary equations are

$$\frac{dx}{-(x + \frac{\partial f}{\partial p})} = \frac{dy}{-(y + \frac{\partial f}{\partial q})} = \frac{dz}{-(px + qy + p\frac{\partial f}{\partial p} + q\frac{\partial f}{\partial q})} = \frac{dp}{-p + p} = \frac{dq}{-q + q}. \tag{2.12}$$

The integration of the last equation of (2.12) gives us $p = a, \quad q = b$. Substituting these values of p and q in the given PDE, we get the required complete integral in the form $z = ax + by + F(a, b)$.

Example 2.8 Find the complete integral of the equation $z = px + qy + \sqrt{1 + p^2 + q^2}$.

Solution: The given PDE is in the Clairaut's form. Hence, its complete integral is $z = ax + by + \sqrt{1 + a^2 + b^2}$.

Example 2.9 Find the complete integral of the equation $(p + q)(z - xp - yq) = 1$.

Solution: The given PDE can be written as $z = xp + yq + \frac{1}{p+q}$ which is the Clairaut's form. Hence, its complete integral is $z = ax + by + \frac{1}{a+b}$.

Example 2.10 Find the characteristic curves of the PDE $u_{yy} - yu_{xx} = 0$ **NET(MS): (June)2013**

Solution: Here $A = -y$, $B = 0$, $C = 1$. So the characteristic curves are given by

$$\frac{dy}{dx} = \pm\frac{\sqrt{4y}}{-2y} \Rightarrow \sqrt{y}dy = \pm dx$$

Integrating, we get, $2y^{\frac{3}{2}} = \pm 3x + c$.

Example 2.11 Solve : $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial y^2} = 0$.

Solution: The PDE $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial y^2} = 0$ can be written as $\left(D^2 - D'^2\right)z = 0$ or $(D+D')(D-D')z = 0$. So $\alpha_1 = 1$, $\beta_1 = 1$, $\gamma_1 = 0$, $\alpha_2 = 1$, $\beta_2 = -1$ and $\gamma_2 = 0$. Therefore, the solution is $z = \phi_1(y-x) + \phi_2(y+x)$ where ϕ_1, ϕ_2 are two arbitrary constants.

Example 2.12 Solve : $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = 0$.

Solution: The PDE $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = 0$ can be written as $\left(D^2 - 2DD' + D'^2\right)z = 0$ or $(D-D')^2 z = 0$. Therefore, the solution is $z = \phi_1(y+x) + x\phi_2(y+x)$ where ϕ_1, ϕ_2 are two arbitrary constants.

Example 2.13 Solve: $(D^2 - 3DD' + 2D'^2)z = e^{(x+2y)}$.

Solution: The given PDE can be written as

$$(D - D')(D - 2D')z = e^{(x+2y)}$$

Therefore, C.F. is $f_1(y+x) + f_2(y+2x)$, where f_1, f_2 are arbitrary functions and the particular integral is

$$\begin{aligned}
\text{P.I.} &= \frac{1}{D^2 - 3DD' + 2D'^2} e^{(x+2y)} \\
&= \frac{e^{(x+2y)}}{1^2 - 3\cdot 1\cdot 2 + 2\cdot 2^2}, \quad \because\ F(1,2) = 1^2 - 3\cdot 1\cdot 2 + 2\cdot 2^2 = 3 \neq 0 \\
&= \frac{e^{(x+2y)}}{3}
\end{aligned}$$

Hence the general solution is $z = C.F. + P.I. = f_1(y+x) + f_2(y+2x) + \frac{e^{(x+2y)}}{3}$.

2.2 Multiple Choice Questions(MCQ)

1. The order of the PDE $p\tan y + q\tan x = \sec^2 z$ is
   (a) 1 (b) 2 (c) 3 (d) 4
   Ans. (a).
2. The PDE $(x+y+z)p + (3x+2y)q + 4z = x + y$ is
   (a) linear (b) non-linear (c) quasi-linear (d) semi-linear
   Ans. (c).
3. The PDE $(2x+3y)p + 4xq - 8pq = x + y$ is
   (a) linear (b) non-linear (c) quasi-linear (d) semi-linear
   Ans. (b).
4. A general solution of the second order equation $4u_{xx} - u_{yy} = 0$ is of the form $u(x,y) = 0$
   (a) $f(x) + f(y)$ (b) $f(x+2y) + g(x-2y)$
   (c) $f(x+4y) + g(x-4y)$ (d) $f(4x+y) + g(4x-y)$. **NET(MS): (Jun)2011**
   Ans. (b).

5. If $u(x,t)$ satisfy the partial differential equation $u_{tt} = 4u_{xx}$, then $u(x,t)$ can be of the form
(a) $u(x,t) = f(e^{x-2t}) + g(x+2t)$ (b) $u(x,t) = f(x^2 - 4t^2) + g(x^2 + 4t^2)$
(c) $u(x,t) = f(2x-4t) + g(x+2t)$ (d) $u(x,t) = f(2x-t) + g(2x+t)$,
where f and g are non-trivial smooth functions. **NET(MS): (Dec.)2012**
Ans. (a) and (c).

6. If $u(x,t)$ be the D'Alembert solution of the initial value problem for the wave equation $u_{tt} - c^2u_{xx} = 0,\ u(x,0) = f(x),\ u_t(x,0) = g(x)$. Where c is a positive real number and f, g are smooth odd functions. Then, $u(0,1)$ is equal to **GATE(MA):2016**
Ans. $u(x,t) = f_1(x-2t) + f_2(x+2t)$. So, $f_1(x) + f_2(x) = f(x)$ and $-cf_1'(x) + cf_2'(x) = g(x)$.

7. A bounded solution to the partial differential equation $u_t = u_{xx} + e^{-t}$ is
(a) $u(x,t) = -e^{-t}$ (b) $u(x,t) = e^{-x}e^{-t}$
(c) $u(x,t) = e^{-x} + e^{-t}$ (d) $u(x,t) = x - e^{-t}$ **NET(MS): (Dec.)2012**
Ans. (a).

8. Consider the first order PDE $p + q = pq$ then which of the following are correct ?
(a) The Charpit's equations for the above PDE reduce to
$\frac{dx}{1-q} = \frac{dy}{1-p} = \frac{dz}{-pq} = \frac{dp}{p+q} = \frac{dq}{0}$.
(b) A solution of the Charpit's equations is $q = b$ where b is constant.
(c) The corresponding value of p is $p = \frac{b}{b-1}$.
(d) A solution of the equation is $z = \frac{b}{b-1}x + by + a$. **NET(MS): (June)2013**
Ans. (b), (c), (d).

9. A general solution of the PDE $uu_x + yu_y = x$ is of the form
(a) $f(u^2 - x^2, \frac{y}{x+u}) = 0$, where $f : \Re^2 \to \Re$ is c^1 and $\nabla f \neq (0,0)$ at every point
(b) $u^2 = g(\frac{y}{x+u}) + x^2,\ g \in c^1(\Re)$
(c) $f(u^2 + x^2) = 0,\ f \in c^1(\Re)$
(d) $f(x+y) = 0,\ f \in c^1(\Re)$. **NET(MS): (June)2011**
Ans. (a), (b).

10. The initial value problem

$$u_x(x,y) + u_y(x,y) = 1,\ u(s,s) = s,\ 0 \leq s \leq 1 \ \textit{has}$$

(a) two solutions (b) a unique solution
(c) No solution (d) infinitely many solution. **GATE: 2008**
Ans. (a).
Hint. Here $y_0'(s)P - x_0'(s)Q = 1 \cdot 1 - 1 \cdot 1 = 0$, using the Theorem 2.2, we have, it has no unique solution. Also, the Lagrange's auxiliary equations are $\frac{dx}{1} = \frac{dy}{1} = \frac{du}{1}$, so that $y - x = c_1,\ u - x = c_2$. Using the initial condition, we have $c_1 = 0$, $c_2 = 0$ i.e., $u = x,\ u = y$ are two solutions.

11. The cauchy problem $u_x(x,y) - u_y(x,y) = 2$ with the conditions as $S : (s, -s, 2s)$ has
(a) one solution (b) two solutions
(c) No solution (d) infinitely many solution. **GATE: 2003**
Ans. (b).
Hint. Here $y_0'(s)P - x_0'(s)Q = -1 \cdot 1 - 1 \cdot (-1) = 0$, using the Theorem 2.2, we have, it has no unique solution. Also, the Lagrange's auxiliary equations are $\frac{dx}{1} = \frac{dy}{-1} = \frac{du}{2}$, so

that $y + x = c_1,\ u - 2x = c_2$. Using the initial condition, we have $c_1 = 0, c_2 = 0$ i.e., $u = 2x,\ u + 2y = 0$ are two solutions.

12. For the cauchy problem $u_t - uu_x = 0,\ x \in \Re,\ t > 0$ with $u(x,0) = x,\ x \in \Re$, which of the following statement is true?.
(a) The solution u exists for all $t > 0$ (b) The solution u exists for all $t < \frac{1}{2}$ and breaks down at $t = \frac{1}{2}$. (c) The solution u exists for all $t < 1$ and breaks down at $t = 1$ (d)The solution u exists for all $t < 2$ and breaks down at $t = 2$. **NET(June):2016**
Ans. (c).

13. The cauchy problem

$$\begin{cases} u_x(x,y) + u_y(x,y) = 0, & (x,y)\epsilon\Re^2 \\ u(s,s) = 0 \end{cases}$$

has
(a) a unique solution, (b) a family of straight lines as characteristics,
(c) Solution which vanishes at (2,1) (d) infinitely many solution. **NET(MS): (June)2011**
Ans. (b), (c), (d).

Hint. Here $y_0'(s)P - x_0'(s)Q = 1 \cdot 1 - 1 \cdot 1 = 0$, using the Theorem 2.2, we have, it has no unique solution. Also, the Lagrange's auxiliary equations are $\frac{dx}{1} = \frac{dy}{1} = \frac{du}{0}$, so that $y - x = c_1,\ u = c_2$.

14. Let $a, b, c, d \in \Re$ be such that $c^2+d^2 \neq 0$. Then the Cauchy problem $au_x+bu_y = e^{x+y},\ x, y \in \Re$ with $u(x,y) = 0$, on $cx + dy = 0$ has a unique solution if **GATE(MA)-2016**
(a) $ac + bd \neq 0$. (b) $ad - bc \neq 0$ (c) $ac - bd \neq 0$. (d) $ad + bc \neq 0$.
Ans. (a).
Hint. Let $x_0(s) = s$, then $y_0(s) = -\frac{cs}{d}$. So, $y_0'(s)P - x_0'(s)Q = -\frac{ac+bd}{d}$. Using the Theorem 2.2, we have, it has unique solution if $-\frac{ac+bd}{d} \neq 0$.

15. Let $a, b \in \Re$ be such that $a^2 + b^2 \neq 0$. Then the Cauchy problem $au_x + bu_y = 1,\ x, y \in \Re$ with $u(x,y) = x$ on $ax + by = 1$ **NET(MS): (June)-2015**
(a) has more than one solution if either a or b is zero. (b) has no solution.
(c) has a unique solution. (d) has infinitely many solutions.
Ans. (c).

16. Consider the initial value problem $u_x + 2u_y = 0,\ u(0,y) = 4e^{-2y}$. Then the value of $u(1,1)$ is **NET(MS): (June)-2015**
(a) $4e^{-2}$ (b) $4e^2$ (c) $4e^{-4}$ (d) $4e^4$
Ans. (b).
Hint. $\frac{dx}{1} = \frac{dy}{2} = \frac{du}{0}$. So $2x - y = c_1$ and $u(x,y) = c_2$ where c_1 and c_2 are arbitrary constants. So, $u(x,y) = f(2x - y)$. Given that $u(0,y) = 4e^{-2y} = f(-y)$. Therefore $u(x,y) = 4e^{(4x-2y)}$ and $u(1,1) = 4e^2$.

17. The PDE

$$\left\{\begin{array}{ll} u_{xx} + u_{yy} + \lambda u = 0, & 0 < x,\ y < 1 \\ u(x,0) = u(x,1) = 0, & 0 \leq x \leq 1 \\ u(0,y) = u(1,y) = 0, & 0 \leq y \leq 1 \end{array}\right\}$$

has **NET(MS): (June)2011**
(a) A unique solution u for any $\lambda \in \Re$ (b) Infinitely many solutions for some $\lambda \in \Re$

(c) A solution for countably many values of $\lambda \in \Re$.(d) Infinitely many solutions $\forall \lambda \in \Re$.
Ans. (b) and (c).

18. The second order PDE $u_{yy} - yu_{xx} + x^3u = 0$ is **NET(MS): (June)2012**

(a) Elliptic for all $x \in \Re,\ y \in \Re$ (b) Parabolic for all $x \in \Re,\ y \in \Re$
(c) Elliptic for all $x \in \Re,\ y < 0$ (d)Hyperbolic for all $x \in \Re,\ y < 0$
Ans. (c).

19. The second order PDE $(\frac{x-y}{4})^2.\frac{\partial^2 u}{\partial x^2} + (x-y)\sin(x^2+y^2)\frac{\partial^2 u}{\partial x \partial y} + \cos^2(x^2+y^2)\frac{\partial^2 u}{\partial y^2} + (x-y)\frac{\partial u}{\partial x} + \sin^2(x^2+y^2)\frac{\partial u}{\partial y} + u = 0$ is,
(a) Elliptic is the region
$$\left\{ \ (x,y); x \neq y, x^2+y^2 < \frac{\pi}{6} \ \right\}$$
(b) Hyperbolic is the region
$$\left\{ \ (x,y); x \neq y, \frac{\pi}{4} < x^2+y^2 < \frac{3\pi}{4} \ \right\}$$
(c) Elliptic is the region
$$\left\{ \ (x,y); x \neq y, \frac{\pi}{4} < x^2+y^2 < \frac{3\pi}{4} \ \right\}$$
(d)Hyperbolic is the region **NET(MS): (Dec.)2011**
$$\left\{ \ (x,y); x \neq y, x^2+y^2 < \frac{\pi}{4} \ \right\}$$
Ans. (b).

20. The second order PDE $u_{xx} + xu_{yy} = 0$ is **NET(MS): (June)-2015**
(a) elliptic for $x > 0$ (b) hyperbolic for $x > 0$ (c) elliptic for $x < 0$ (d) hyperbolic for $x < 0$.
Ans. (a) and (d).

21. The complete integral of the PDE
$\frac{\partial^2 u}{\partial x^2} + 2\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = xe^{x+y}$
involving arbitrary function Φ_1 and Φ_2 is
(a)$\Phi_1(y+x) + \Phi_2(y+x) + \frac{1}{4}e^{x+y}$. (b)$\Phi_1(y+x) + x\Phi_2(y+x) + \frac{x-1}{4}e^{x+y}$.
(c)$\Phi_1(y-x) + \Phi_2(y-x) + \frac{1}{4}e^{x+y}$. (d)$\Phi_1(y-x) + x\Phi_2(y-x) + \frac{x-1}{4}e^{x+y}$. **NET(MS): (Dec.)2011**
Ans. (d).

22. Let $u = u(x,y)$ be the complete integral of the PDE $pq = xy$ passing through the point $(0,0,1)$ and $(0,1,\frac{1}{2})$ in the $x-y-z$ space.
Then the value of the $u(x,y)$ evaluated at $(-1,1)$ is **NET(MS): (Dec.)2011**
(a) 0 (b) 1 (c) 2 (d) 3.
Ans. (a).

23. A solution of the PDE $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + (\frac{\partial u}{\partial x})^2 + (\frac{\partial u}{\partial y})^2 - u = 0$ represents **NET(MS):(Dec.)-15**
(a) an ellipse in the $x-y$ plane. (b) an ellipsoid in the xyu space.
(c) a parabola in the $u-x$ plane. (d) a hyperbola in the $u-y$ plane.
Ans. (c).

24. Let $u(x,t)$ be the solution of the initial boundary value problem , $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}, 0 < x < \infty, t > 0$
$u(x,0) \ = \ cos(\frac{\pi x}{2}), 0 \leq x < \infty$

$$\frac{\partial u}{\partial t}(x,0) = 0, 0 \le x < \infty$$
$$\frac{\partial u}{\partial x}(0,t) = 0, t \ge 0.$$

then, **NET(MS): (Dec.)2011**

(a) The value of $u(2,2) = -1$ (b) The value of $u(2,2) = 1$
(c) The value of $u(\frac{1}{2},\frac{1}{2}) = \frac{1}{\sqrt{2}}$ (d) The value of $u(\frac{1}{2},\frac{1}{2}) = \frac{1}{2}$.
Ans. (b) and (d).

25. The differential equation $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0$ with $u(x,y) = x$ on $x^2 + y^2 = 1$ has
(a) a solution for all $x \in \Re$, $y \in \Re$ **NET(MS): (June)2012**
(b) a unique solution in $\{(x,y) \in \Re^2 : (x,y) \neq (0,0)\}$
(c) a bounded solution in $\{(x,y) \in \Re^2 : (x,y) \neq (0,0)\}$
(d) a unique solution in $\{(x,y) \in \Re^2 : (x,y) \neq (0,0)\}$ but the solution is unbounded.
Ans. (b) and (c).

26. The differential equation $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2u$ satisfying the initial condition $y = xg(x), u = f(x)$ with
(a) $f(x) = 2x, g(x) = 1$, has no solution (b) $f(x) = 2x^2, g(x) = 1$, has infinite no of solution
(c) $f(x) = x^3, g(x) = x$, has a unique solution solution (d) $f(x) = x^4, g(x) = x$, has a unique solution. **NET(MS): (Dec.)2011**
Ans. (a) and (c).

27. For an arbitrary continuously differentiable function f, which of the following is a general solution of $z(px - qy) = y^2 - x^2$ **NET(MS): (June)-2015**
(a) $x^2 + y^2 + z^2 = f(xy)$ (b) $(x+y)^2 + z^2 = f(xy)$ (c) $x^2 + y^2 + z^2 = f(y - y)$ (d) $x^2 + y^2 + z^2 = f((x+y)^2 + z^2)$.
Ans. (a), (b) and (d).

28. The solution of the Cauchy problem for the first order PDE $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = z$, on $D = \{(x,y,z)|x^2 + y^2 \neq 0, z > 0,\}$ with initial condition $x^2 + y^2 = 1$, $z = 1$ is **NET(MS): (June)2013**
(a) $z = x^2 + y^2$ (b) $z = (x^2 + y^2)^2$ (c) $z = 2 - \sqrt{x^2 + y^2}$ (d) $z = \sqrt{x^2 + y^2}$.
Ans. (d) $z = \sqrt{x^2 + y^2}$.

29. The characteristic curve of $2yu_x + (2x + y^2)u_y = 0$
passing through $(0,0)$ is ,
(a)$y^2 = 2(e^x + x - 1)$ (b) $y^2 = 2(e^x - x + 1)$
(c) $y^2 = 2(e^x - x - 1)$ (d) $y^2 = (e^x + x + 1)$. **GATE(MA)-08**
Ans. (c).
Hint. $\frac{dy}{dx} = \frac{Q(x,y,z)}{P(x,y,z)} = \frac{2y}{2x+y^2}$ is referred to as characteristic curve.

30. The PDE $u_{yy} - yu_{xx} = 0$ has **NET(MS): (June)2013**
(a) two families of real characteristic curves for $y < 0$
(b) no real characteristic curves for $y > 0$
(c) vertical lines as a family of characteristic curves for $y = 0$
(d) branches of quadratic curves as characteristic for $y \neq 0$.
Ans. (c) vertical lines as a family of characteristic curves for $y = 0$
Hint. The two characteristic curves are given by $\frac{dy}{dx} = \frac{B \pm \sqrt{B^2 - 4AC}}{2A}$. Here, $A = -y$, $B = 0$, $C = 1$.

31. The number of characteristic curves of the PDE $(x^2 + 2y)u_{xx} + (y^3 - y + x)u_{yy} + x^2(y-1)u_{xy} +$

$3u_x + u = 0$ passing through through the point $x = 1, y = 1$ is
(a) 0 (b) 1 (c) 2 (d) 3. **NET(MS): (Jun)2011**
Ans. (c).
Hint. The characteristic curves are given by $\frac{dy}{dx} = \frac{B \pm \sqrt{B^2-4AC}}{2A}$. Here, $A = x^2 + 2y$, $B = x^2(y-1)$, $C = y^3 - y + x$.

32. The partial differential equation $xu_{yy} + yu_{xx} = 0$ is hyperbolic in **NET(MS): (Dec.)2012**
(a) the second and fourth quadrants. (b) the first and second quadrants.
(c) the second and third quadrants. (d) the first and third quadrants.
Ans. (a).

33. Let $u(x,y) = 2f(y)\cos(x-2y)$, $(x,y) \in \Re^2$, be a solution of the initial value problem $2u_x + u_y = u$, $u(x,0) = \cos x$. Then $f(1)$ is equal to
(a) $\frac{1}{2}$ (b) $\frac{e}{2}$ (c) e (d) $\frac{3e}{2}$ **GATE(MA)-15**
Ans. (b).
Hint. Here $2u_x + u_y = 2f'(y)\cos(x-2y) = u = 2f(y)\cos(x-2y)$, so $f'(y) = f(y)$ and integrating, we get $f(y) = Ae^y$. Also, $u(x,0) = 2f(y)\cos x = \cos x$ gives $A = f(0) = \frac{1}{2}$.

34. Let $u(x,t)$ be the solution of $u_{xx} = u_{tt}$, $x \in \Re$ with $u(x,0) = 0$ and $u_t(x,0) = \cos x$. Then the value of $u(0, \frac{\pi}{2})$ is
(a) 0 (b) 1 (c) 2 (d) 3. **GATE(MA)-14**
Ans. (b).
Hint. $u(x,t) = f(x+t) + g(x-t)$ and so $f(x) + g(x) = 0$, $f'(x) - g'(x) = \cos x$. Therefore, $u(0, \frac{\pi}{2}) = f(\frac{\pi}{2}) + g(-\frac{\pi}{2}) = 1$. Hence (b) is correct.

35. Let $u(x,t)$, $x \in \Re$, $t \geq 0$ be the solution of the initial value problem $u_{xx} = u_{tt}$, $u(x,0) = x$ and $u_t(x,0) = 1$. Then the value of $u(2,2)$ is
(a) 1 (b) 2 (c) 3 (d) 4. **GATE(MA)-15**
Ans. (d).
Hint. $u(x,t) = f(x+t)+g(x-t)$ and $u_t(x,t) = f'(x+t)-g'(x-t)$. Putting $t = 0$ and integrating, we get, $f(x)+g(x) = x$ and $f'(x)-g'(x) = 1$. So, $f(0)+g(0) = 0$ and $f(x)-g(x) = x+f(0)-g(0)$, i.e., $g(x) = g(0)$. Therefore, $u(2,2) = f(4) + g(0) = f(4) + g(4) = 4$.

36. Let $u(x,t)$ be the equation of $u_{xx} = u_{tt}$, $u(x,0) = \cos(5\pi x)$ and $u_t(x,0) = 0$. Then the value of $u(1,1)$ is
(a) 1 (b) 2 (c) 3 (d) 4. **GATE(MA)-13**
Ans. (a).
Hint. $u(x,t) = f(x+t) + g(x-t)$ and $u_t(x,t) = f'(x+t) - g'(x-t)$. Putting $t = 0$ and integrating, we get, $f(x) + g(x) = \cos(5\pi x)$ and $f(x) - g(x) = f(0) - g(0)$. So, $f(0) + g(0) = 1$ and $f(x) + g(0) = \frac{1+\cos(5\pi x)}{2}$. Therefore, $u(1,1) = f(2) + g(0) = 1$.

37. Consider the wave equation
$$\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}, 0 < x < \pi, t > 0$$
with $u(0,t) = u(\pi,t) = 0, u(x,0) = \sin x$ and $\frac{\partial u}{\partial t} = 0$ at $t = 0$.
The $u(\frac{\pi}{2}, \frac{\pi}{2})$ is
(a) 2 , (b) 1 , (c) 0 , (d) -1. **GATE(MA)-10**
Ans. (d).
Hint. $u(x,t) = f(x-2t) + g(x+2t)$, so $f(-2t) + g(2t) = 0$, $f(\pi - 2t) + g(\pi + 2t) = 0$ and $f(x) + g(x) = \sin x$. Then $u(\frac{\pi}{2}, \frac{\pi}{2}) = f(-\frac{\pi}{2}) + g(\frac{3\pi}{2}) = -g(\frac{\pi}{2}) + g(\frac{3\pi}{2}) = f(\frac{\pi}{2}) + g(\frac{3\pi}{2}) - \sin\frac{\pi}{2} =$

$0 - 1 = -1$.

38. Let $u(x,t)$ satisfy the wave equation $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}, 0 < x < 2\pi, t > 0$ with $u(x,0) = e^{i\omega x}$ for some $\omega \in \Re$. Then **NET(MS):(Dec.)-2015**
(a) $u(x,t) = e^{i\omega x}e^{i\omega t}$. (b) $u(x,t) = e^{i\omega x}e^{-i\omega t}$.
(c) $u(x,t) = e^{i\omega x}\frac{e^{i\omega t}+e^{-i\omega t}}{2}$. (d) $u(x,t) = t + \frac{x^2}{2}$.
Ans. (a), (b), (c).

39. Which of the following are complete integrals of the partial differential equation $pqx+yq^2 = 0$? **NET(MS):(June)-2015**
(a) $u = \frac{x}{a} + \frac{ay}{x} + b$ (b) $u = \frac{x}{b} + \frac{ay}{x} + b$ (c) $u^2 = 4(ax+y)+b$ (d) $(u-b)^2 = 4(ax+y)$.
Ans. (a), (d).

40. Consider the heat equation $u_{xx} = u_t$ with $u(0,t) = u(\pi,t) = 0$ and the initial condition $u(x,0) = \sin x$. Then the value of $u(\frac{\pi}{2},0)$ is
(a) 0 (b) 1 (c) 2 (d) 3. **GATE(MA)-14**
Ans. (b).
Hint. $u(x,t) = e^{-t}\sin x$ and so $u(\frac{\pi}{2},0) = 1$. Hence (b) is correct.

41. The integral surface of PDE $2y(z-3)\frac{\partial z}{\partial x} + (2x-z)\frac{\partial z}{\partial y} = y(2x-3)$ passing through the circle $z = 0,\ x^2+y^2 = 2x$ is
(a) $x^2+y^2-z^2-2x+4z = 0$ (b) $x^2+y^2-z^2-2x+8z = 0$
(c) $x^2+y^2-z^2-2x+16z = 0$ (d) $x^2+y^2+z^2-2x+8z = 0$ **GATE(MA)-14**
Ans. (a).

42. The partial differential equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}, u = u(x,t), u(0,t) = 0 = u(\pi,t)$, and $u(x,0) = \cos x \sin 5x$ admits the solution
(a) $\frac{e^{-36t}}{2}[\sin 6x + e^{20t}\sin 4x]$ (b) $\frac{e^{-36t}}{2}[\sin 4x + e^{20t}\sin 6x]$
(c) $\frac{e^{-20t}}{2}[\sin 3x + e^{15t}\sin 5x]$ (d) $\frac{e^{-36t}}{2}[\sin 5x + e^{20t}\sin x]$. **GATE(MA)-12**
Ans. (a).
Hint. Using the section**??**, we have, $u(x,t) = \sum_{r=0}^{\infty} A_r \sin \mu_r x e^{-(c^2\mu_r^2)t}$. From the above problem with given condition, we have, $c = 1$ and $A_1 \sin \mu_1 x + A_2 \sin \mu_2 x = \cos x \sin 5x = \frac{1}{2}(\sin 6x + \sin 4x)$, so $A_1 = A_2 = \frac{1}{2},\ \mu_1 = 6$ and $\mu_2 = 4$. Therefore the solution is $u(x,t) = \frac{e^{-(6^2\cdot 1^2)t}}{2}\sin 6x + \frac{e^{-(4^2\cdot 1^2)t}}{2}\sin 4x = \frac{e^{-36t}}{2}[\sin 6x + e^{20t}\sin 4x]$.

43. The differential equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}, u = u(x,t),\ 0 < x < \pi,\ t > 0$ with $u(0,t) = 0 = u(\pi,t),\ t > 0$ and $u(x,0) = \sin x + \sin 2x,\ 0 \le x \le \pi$. Then
(a) $u(x,t) \to 0$ as $t \to 0$ for all $x \in (0,\pi)$
(b) $t^2u(x,t) \to 0$ as $t \to 0$ for all $x \in (0,\pi)$
(c) $e^1u(x,t)$ is a bounded function for $x \in (0,\pi),\ t > 0$
(d)$e^2(x,t) \to 0$ as $t \to 0$ for all $x \in (0,\pi)$ **NET(MS): (June)2012**
Ans. (a), (b) and (c).
Hint. Using the section**??**, we have, $u(x,t) = \sum_{r=0}^{\infty} A_r \sin \mu_r x e^{-(c^2\mu_r^2)t}$. From the above problem with given condition, we have, $c = 1$ and $A_1 \sin \mu_1 x + A_2 \sin \mu_2 x = \sin x + \sin 2x$, so $A_1 = A_2 = 1,\ \mu_1 = 1$ and $\mu_2 = 2$. Therefore the solution is $u(x,t) = e^{-(1^2\cdot 1^2)t}\sin x + e^{-(2^2\cdot 1^2)t}\sin 2x = e^{-t}\sin x + e^{-4t}\sin 2x]$.

44. Let $P(x,y)$ be a particular integral of the PDE $z_{xx} - z_y = 2y - x^2$. Then $P(2,3)$ equals

NET(MS): (Dec.)2013
(a) 2 (b) 8 (c) 12 (d) 10
Ans. (c).

45. The PDE $u_t = u_{xx} + u$ can e transformed to $v_t = v_{xx}$ for **NET(MS): (Dec.)2013**
(a) $v = e^{-t}u$ (b) $v = e^{t}u$ (c) $v = tu$ (d) $v = tu$
Ans. (a).

46. The partial differential equation
$x^2\frac{\partial^2 z}{\partial x^2} - (y^2-1)x\frac{\partial^2 z}{\partial x\partial y} + y(y-1)^2\frac{\partial^2 z}{\partial y^2} + x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = 0$
is hyperbolic in a region in XY- plane if
(a) $x \neq 0$ and $y = 1$ (b) $x = 0$ and $y \neq 0$
(c) $x \neq 0$ and $y \neq 1$ (d) $x = 0$ and $y = 1$. **GATE(MA)-11**
Ans. (c).

47. Let a, b, c, d be four differentiable functions defined on $\Re^2$. Then the partial differential equation $(a(x,y)\frac{\partial}{\partial x} + b(x,y)\frac{\partial}{\partial y})(c(x,y)\frac{\partial}{\partial x} + d(x,y)\frac{\partial}{\partial y})u = 0$ is
(a) always hyperbolic (b) always parabolic (c) never parabolic (d) never elliptic
Ans. (d). **NET(June)-16**

48. The integral surface for the cauchy problem $\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 1$ which passes through the circle $z = 0, x^2 + y^2 = 1$ is
(a) $x^2 + y^2 + 2z^2 + 2zx - 2yz - 1 = 0$ (b) $x^2 + y^2 + 2z^2 + 2zx + 2yz - 1 = 0$
(c) $x^2 + y^2 + 2z^2 - 2zx - 2yz - 1 = 0$ (d) $x^2 + y^2 + 2z^2 + 2zx + 2yz + 1 = 0$. **GATE(MA)-10**
Ans. (c).

49. The vertical displacement $u(x,t)$ of an infinitely long elastic string is is governed by the initial value problem
$\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}, -\infty < x < \infty, t > 0$
$u(x,0) = -x$ and $\frac{\partial u}{\partial t}(x,0) = 0$
The value of $u(x,t)$ at $x = 2$ and $t = 2$ is equal to
(a) 2 , (b) 4 , (c) -2 , (d) -4. **GATE(MA)-11**
Ans. (c).

50. The general solution of the PDE $\frac{\partial^2 z}{\partial x\partial y} = x + y$ is of the form
(a)$\frac{1}{2}xy(x+y) + F(x) + G(y)$ (b) $\frac{1}{2}xy(x-y) + F(x) + G(y)$
(c) $\frac{1}{2}xy(x-y) + F(x).G(y)$ (d) $\frac{1}{2}xy(x+y) + F(x).G(y)$. **GATE(MA)-10**
Ans. (a).

51. The PDE $\frac{\partial^2 u}{\partial x^2} + 2\frac{\partial^2 u}{\partial x\partial y} + \frac{\partial^2 u}{\partial y^2} = x$ has **NET(MS):(Dec.)-15**
(a) only one particular integral (b) a particular integral which is linear in x and y.
(c) a particular integral which is quadratic polynomial in x and y. (d) more than one particular integral.
Ans. (d).

52. Consider the Laplace equation in polar form : $\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0, 0 < r < a, 0 \leq \theta < 2\pi$ subject to the condition $u(a,\theta) = f(\theta)$, where f is the given function. Let σ be the separation constant that appears when one uses the method of separation of variables. Then for solution $u(r,\theta)$ to be bounded and also periodic in $\theta$with period 2π, **NET(MS): (June)2013**
(a) σ can not negative, (b) σ can be zero and in that case the solution is a constant
(c)σ can be positive and in that case the solution must be an integer

(d) the fundamental set of solutions is $\{1, r^n \sin n\theta, r^n \cos n\theta\}$, where n is a positive integer.
Ans. (a), (b), (c) (d).
Hint. Let $u(r,\theta) = u(r)v(\theta)$, then the problem becomes $\frac{r^2u''(r)+ru'(r)}{u(r)} = -\frac{v''(\theta)}{v(\theta)} = \sigma$.

53. The function $u(r,\theta)$ satisfying the Laplace equation
$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0, e < r < e^2$ subject to the condition $u(e,\theta) = 1, u(e^2,\theta) = 0$. Then $u(r,0)$ is
(a) $ln(\frac{e}{r})$, (b) $ln(\frac{e}{r^2})$,
(c) $ln(\frac{e^2}{r})$, (d) $\sum_{n=1}^{\infty}(\frac{r-e^2}{l-e^2})\sin(n\theta)$. **GATE(MA)-12**
Ans. (c).

54. The integral surface satisfying the equation $y\frac{\partial z}{\partial x} + x\frac{\partial z}{\partial y} = x^2 + y^2$ and passing through the curve $x = 1-t, y = 1+t, z = 1+t^2$ is
(a)$z = xy + \frac{1}{2}(x^2-y^2)^2$ (b) $z = xy + \frac{1}{4}(x^2-y^2)^2$
(c) $z = xy + \frac{1}{8}(x^2-y^2)^2$ (d) $z = xy + \frac{1}{16}(x^2-y^2)^2$. **GATE(MA)-09**
Ans. (c).

55. The solution of the initial value problem $(x-y)\frac{\partial u}{\partial x} + (y-x-u)\frac{\partial u}{\partial y} = u$ with $u(x,0) = 1$ satisfies **NET(MS):(Dec.)-15**
(a) $u^2(x-y+u) + (y-x-u) = 0$. (b) $u^2(x+y+u) + (y-x-u) = 0$.
(c) $u^2(x-y+u) - (y+x+u) = 0$. (d) $u^2(y-x+u) + (x+y-u) = 0$.
Ans. (b).

56. For the diffusion problem
$u_{xx} = u_t (0 < x < \pi, t > 0)$
$u(0,t) = 0, u(\pi,t) = 0$ and $u(x,0) = 3\sin 2x$
the solution is given by ,
(a) $3e^{-t}\sin 2x$, (b) $3e^{-4t}\sin 2x$, (c) $3e^{-9t}\sin 2x$,(d) $3e^{-2t}\sin 2x$. **GATE(MA)-09**
Ans. (b).

57. The solution of the $xu_x + yu_y = 0$ is of the form
(a) $f(\frac{y}{x})$, (b) $f(x+y)$, (c) $f(x-y)$, (d) $f(xy)$. **GATE(MA)-08**
Ans. (a).

58. If the PDE $(x-1)^2u_{xx} - (y-2)^2u_{yy} + 2xu_x + 2yu_y + 2xyu = 0$
is parabolic in $S \subseteq R$ but not in $\frac{R^2}{S}$ then S is
(a) $\left\{(x,y) \in R^2, x = 1 \ or \ y = 2\right\}$, (b) $\left\{(x,y) \in R^2, x = 1 \ and \ y = 2\right\}$,
(c) $\left\{(x,y) \in R^2, x = 1\right\}$, (d) $\left\{(x,y) \in R^2, y = 2\right\}$. **GATE(MA)-08**
Ans. (a).

59. Let $u(x,y) = f(x,y) + g(y^2cos(y))$
Where f and g are infinitely differentiable function . Then the PDE of minimum order satisfied by u is ,
(a)$u_{xx} + xu_{xx} = u_x$ (b) $u_{xy} + xu_{xx} = xu_x$ (c)$u_{xy} - xu_{xx} = u_x$ (d) $u_{xy} - xu_{xx} = xu_x$.**GATE(MA)-08**
Ans. (c).

60. Consider the Neumann problem

$$u_{xx} + u_{yy} = 0, 0 < x < \pi, -1 < y < 1$$
$$u_x(0,y) = u_x(\pi,y) = 0$$
$$u_y(x,-1) = 0, u_y(x,1) = \alpha + \beta\sin x$$

The problem admits solution for ,
(a) $\alpha = 0, \beta = 1$, (b) $\alpha = -1, \beta = \frac{\pi}{2}$ (c) $\alpha = 1, \beta = \frac{\pi}{2}$, (d) $\alpha = 1, \beta = -\pi$.
Ans. (a). **GATE(MA)-08**

61. In the region $x > 0, y > 0$, the PDE $(x^2 - y^2)\frac{\partial^2 u}{\partial x^2} + 2(x^2 + y^2)\frac{\partial^2 u}{\partial x \partial y} + (x^2 - y^2)\frac{\partial^2 u}{\partial y^2} = 0$ is
(a) Changes type (b) elliptic (c) parabolic (d)hyperbolic. **GATE(MA)-08**
Ans. (d).

62. $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0, u(x, 0) = \sin x, \frac{\partial u}{\partial t}(x, 0) = 1$
then $u(\pi, \frac{\pi}{2}) =$
(a) $\frac{\pi}{2}$, (b) $1 - \frac{\pi}{2}$, (c) 1 , (d) $1 + \pi$. **GATE(MA)-07**
Ans. (a).

63. Complete integral for the PDE $z = px + qy - \sin pq$ is
(a) $z = ax + by + \sin(ab)$ (b) $z = ax + by + \sin b$
(c) $z = ax + by - \sin(ab)$ (d) $z = ax + by - \sin a$ **GATE(MA)-06**
Ans. (c).

64. Pick the region in which the partial differential equation $yu_{xx} + 2xyu_{xy} + xu_{yy} = u_x + u_y$ is hyperbolic
(a) $xy \neq 1$ (b) $xy \neq 0$ (c) $xy > 1$ (ab) (d) $xy > 0$ **GATE(MA)-05**
Ans. (c).

Chapter 3

Numerical Analysis

3.1 Multiple Choice Questions(MCQ)

1. The number of significant figures in 0.0128742? **MCA-09, 11**
   (a) Five (b) Six (c) Seven (d) Three
   Ans. (b)

2. The number of significant digits in 1.00234? **CS-312/07**
   (a) 6 (b) 5 (c) 3 (d) 4
   Ans. (a)

3. The number 9.6506531 when round off to 4 places of decimal will give **CS-301/12**
   (a) 3.6506 (b) 9.6507 (c) 9.6505 (d) none of these
   Ans. (b)

4. The percentage error in approximating $\frac{4}{3}$ to 1.3333 is ? **CS-312/07**
   (a) 0.0025% (b) 25% (c) 0.00025% (d) 0.25%
   Ans. (a)

5. The number of significant digits in $6, 00, 000$? **CS-312/09**
   (a) 0 (b) 1 (c) 6 (d) 7
   Ans. (b)

6. The percentage error in approximating $\frac{4}{3}$ to 1.3333 is ? **CS-312/10**
   (a) 0.0025% (b) 25% (c) 0.00025% (d) 0.25 %
   Ans. (a)

7. The ratio of absolute error of the true value is called **CS-312/11**
   (a) relative error (b) absolute error (c) truncation error (d) inherent error
   Ans. (b)

8. The kind of error occurs when π approximated by 3.14 is **CS-312/11, 13**
   (a) relative error (b) round off error (c) truncation error (d) inherent error
   Ans. (b)

9. If $'a'$ is the actual value and $'e'$ is the estimated value, the formula for relative error is **MCA-09**

(a) $\frac{a}{e}$ (b) $\frac{a-e}{e}$ (c) $\frac{|a-e|}{a}$ (d) $\frac{|a-e|}{e}$
Ans. (c)

10. The maximum absolute error that occurs in rounding off a number after 6 places of decimal is (A) 5×10^{-8} (B) 10×10^{-7} (C) 5×10^{-7} (D)5×10^{-6} **GATE-03**
Ans. (C)

11. If the number 0.246 rounded up to two significant figure is 0.25, then the number 246 rounded up to two significant figure will be (A) 24 (B) 25 (C) 240 (D) 250
Ans.(D)

12. If $f(x) = \frac{1}{x^2}$ then the divided difference $f[a, b]$ is **WBUT-11, 12**
(a) $-\frac{a+b}{(ab)^2}$ (b) $\frac{a-b}{(ab)^2}$ (c) $\frac{1}{a^2} - \frac{1}{b^2}$ (d) $\frac{1}{a^2-b^2}$
Ans. (a) $-\frac{a+b}{(ab)^2}$
Solution. $f[a, b] = \frac{f(a)-f(b)}{a-b} = \frac{\frac{1}{a^2}-\frac{1}{b^2}}{a-b}$

13. If $f(x) = \frac{1}{x}$ then the divided difference $f[a, b, c]$ is **WBUT-08, 12**
(a) $\frac{1}{a} - \frac{1}{b} - \frac{1}{c}$ (b) $(\frac{1}{a} - \frac{1}{b}) - (\frac{1}{b} - \frac{1}{c})$ (c) $\frac{1}{abc}$ (d) $(\frac{1}{a} - \frac{1}{b}) + (\frac{1}{b} - \frac{1}{c})$
Ans. (c) $\frac{1}{abc}$
Solution. $f[a, b, c] = \frac{f[a,b]-f[b,c]}{a-c}$.

14. The first order forward difference of a constant function is **CS/ BCA-10**
(a) 0 (b) 4 (c) 3 (d) 1
Ans. (a) 0
Solution. $\Delta f(x) = f(x + h) - f(x) = c - c = 0$.

15. $\delta E^{\frac{1}{2}}$ is equal to **CS/ BCA-10**
(a) ∇ (b) Δ (c) E (d) None of these
Ans. (b) Δ
Solution. $\delta E^{\frac{1}{2}} = (E^{\frac{1}{2}} - E^{-\frac{1}{2}})E^{\frac{1}{2}} = E - 1 = \Delta$.

16. Which of the following is true ? **WBUT-09,12**
(a) $\Delta^n x^n = (n + 1)!$ (b) $\Delta^n x^n = n!$ (c) $\Delta^n x^n = 0$ (d) $\Delta^n x^n = n$
Ans. (b) $\Delta^n x^n = n!$

17. Which of the following is true ? **WBUT-09, 12, 13**
(a) $E \equiv 1 - \Delta$ (b) $E \equiv 1 + \Delta$ (c) $\Delta \equiv 1 + E$ (d) $E \equiv \frac{1}{\Delta}$
Ans. (b) $E \equiv 1 + \Delta$

18. The value of $\left(\frac{\Delta^2}{E}\right)x^3$ is **WBUT-07, 12**
(a) x (b) $6x$ (c) $3x$ (d) x^2
Ans. (b) $6x$

19. The value of $\Delta^{10}[(1 - ax)(1 - bx^2)(1 - cx^3)(1 - dx^4)]$ **GATE-08**.
(a) $abcd(10)!$ (b) 10! (c) $abcd$ (d) $10abcd$
Ans. (a) $abcd(10)!$

20. If the interval of differencing in unity and $f(x) = ax^2$ (a is constant), which one of the following choices is wrong ? **WBUT-11**

    (a) $\Delta f(x) = a(2x + 1)$ (b)$\Delta^2 f(x) = 2a$ (c) $\Delta^3 f(x) = 2$ (d) $\Delta^4 f(x) = 0$
    Ans. (c) $\Delta^3 f(x) = 2$
    Hints. The $f(x) = ax^2$ is of degree 2 in x, so, $\Delta^3 f(x) = 0$

21. $\Delta^3 y_0$ may be expressed as **WBUT-08**

    (a) $y_3 - 3y_2 + 2y_1 - y_0$ (b)$y_2 - 2y_1 + y_0$ (c) $y_3 + 3y_2 + 3y_1 + y_0$ (d) None of these
    Ans. (a) $y_3 - 3y_2 + 2y_1 - y_0$
    Hints. The $\Delta^3 y_0 = (E - 1)^3 y_0 = E^3 y_0 - 3E^2 y_0 + 3Ey_0 - y_0$

22. $(\Delta - \nabla)x^2$ is equal to **WBUT-09**

    (a) h^2 (b)$-2h^2$ (c) $2h^2$ (d) None of these
    Ans. (c) $2h^2$

23. Which of the following is true ? **WBUT-09**
    (a) $(1 + \Delta)(1 - \nabla) \equiv 1$ (b) $(1 + \Delta)(1 + \nabla) \equiv I$ (c) $\Delta \equiv 1 + E$ (d) $E \equiv \frac{1}{\Delta}$
    Ans. (a) $(1 + \Delta)(1 - \nabla) \equiv 1$

24. $x^2 - 2x + 1$ is equal to **WBUT-09**

    (a) $[x]^2 + 1$ (b)$[x]^2 + [x] + 1$ (c) $[x]^2 - [x] + 1$ (d) None of these
    Ans. (c) $[x]^2 - [x] + 1$
    Hints. $x^2 - 2x + 1 = x(x - 1) - x + 1 = [x]^2 - [x] + 1$.

25. In Newton's forward interpolation formula, the interval should be **WBUT-08**
    (a) equally spaced (b) not equally spaced (c)may be equally spaced (d) both (a) and (b)
    Ans. (a)equally spaced.

26. If $f(0) = 12$, $f(3) = 6$, and $f(4) = 8$, then the linear interpolation function $f(x)$ is **WBUT-10,11**
    (a) $x^2 - 3x + 12$ (b) $x^2 - 5x$ (c) $x^3 - x^2 - 5x$ (d) $x^2 - 5x + 12$
    Ans. (d) $x^2 - 5x + 12$
    Hints: $f(x) = x^2 - 5x + 12$, then, $f(0) = 12$, $f(3) = 6$ and $f(4) = 8$.

27. Lagrange interpolation formula, the interval should be **WBUT-07, 08, 10, 11**
    (a) equally spaced (b) not equally spaced (c)both (a) and (b) (d) none of these
    Ans. (c)both (a) and (b).

28. Geometrically Lagrange interpolation formula for two points of interpolation represents a
    (a) parabola (b) straight line (c) circle (d) none of these
    Ans. (b) straight line.

29. If n values of f(x) are given, then $f(x)$ can be approximate by a polynomial of degree **WBUT-10**
(a) n (b) $n-1$ (c) $n+1$ (d) none of these
Ans. (b) $n-1$.

30. Striling's formula is suitable for **CS/ MCA-07**
(a) $-0.25 < s < 0.25$ (b) $0.25 < s < 0.75$ (c) $s \leq 0$ (d) None of these
Ans. (a)$-0.25 < s < 0.25$.

31. Striling's formula is the average of **CS/ MCA-09**
(a) Gauss's forward and backward formula (b) Newton's forward and backward formula (c) any one of these (d) None of these
Ans. (a)Gauss's forward and backward formula.

32. In Newton's forward interpolation formula, the value of $\frac{x-x_0}{h}$ lies between
(a) 1 and 2 (b) -1 and 1 (c) 0 and ∞ (d) 0 and 1
Ans. (d) 0 and 1.

33. The Newton's forward interpolation formula is used to interpolate
(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (c) near beginning.

34. The Newton's backward interpolation formula is used to interpolate
(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (a) near end.

35. In Newton's backward interpolation formula, the value of $\frac{x-x_n}{h}$ lies between
(a) -1 and 0 (b) -1 and 1 (c) 0 and ∞ (d) 0 and 1
Ans. (a) -1 and 0.

36. The Gauss's interpolation formula is used to interpolate
(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (b) near central position.

37. If $y = f(x)$ are known only at $(n+1)$ distinct interpolating points then the Lagrange polynomial has degree
(a) at most n (b) at least n (c) exactly n (d) exactly $(n+1)$.
Ans. (a) at most n.

38. If $y = f(x)$ are given at $(n+1)$ distinct points, then the interpolating polynomial is
(a) unique (b) not unique (c) has a degree at least n+1 (d) exactly (n+1).
Ans. (a) unique.

39. If $f(0) = 4$, $f(3) = 13$, and $f(4) = 20$, then the linear interpolation function $f(x)$ is
(a) x^2+4 (b) x^2-12 (c) x^2-4 (d) none
Ans. (a) x^2+4
Hints: $f(x) = x^2+4$ then, f(0)=4, f(3)=13 and f(4)=20.

40.

x	1	2	3	4	5
y	-1	2	-3	4	-5

If the derivative of $y(x)$ is approximated as : $y'(x) \approx \frac{1}{h}\Big(\Delta y_k +$

$\frac{1}{2}\Delta^2 y_k - \frac{1}{4}\Delta^3 y_k\Big)$, then find the value of $y'(2)$. **GATE/ MA- 12**

(a) 8.0 (b) 9.0 (c) 7.0 (d) 7.6

Ans. (a) 8.0

Hints: The forward difference table is

x:	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$
1	−1	3	−8	20	−48
2	2	−5	12	−28	
3	−3	7	−16		
4	4	−9			
5	−5				

Here, $h = 1$ and

$$\begin{aligned} y'(2) &\approx \frac{1}{h}\Big(\Delta y_k + \frac{1}{2}\Delta^2 y_k - \frac{1}{4}\Delta^3 y_k\Big) \\ &= -5 + \frac{12}{2} - \frac{-28}{4} \\ &= 8 \end{aligned}$$

Hence $y'(2) = 8$.

41. In Newton's forward inverse interpolation formula, the interval should be
(a) equally spaced (b) not equally spaced (c)may be equally spaced (d) both (a) and (b)
Ans. (a)equally spaced.

42. Lagrange inverse interpolation formula, the interval should be
(a) equally spaced (b) not equally spaced (c)both (a) and (b) (d) none of these
Ans. (c)both (a) and (b).

43. The Newton's forward inverse interpolation formula is used to interpolate
(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (c) near beginning.

44. The Newton's backward inverse interpolation formula is used to interpolate
(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (a) near end.

45. If $x = F(y)$ are known only at $(n+1)$ distinct interpolating points then the Lagrange polynomial has degree
(a) at most n (b) at least n (c) exactly n (d) exactly $(n+1)$.
Ans. (a) at most n.

46. If $x = F(x)$ are given at $(n+1)$ distinct points, then the inverse interpolating polynomial is
(a) unique (b) not unique (c) has a degree at least $n+1$ (d) exactly $n+1$.
Ans. (a) unique.

47. In differentiation based Newton's forward interpolation formula, the interval should be

(a) equally spaced (b) not equally spaced (c)may be equally spaced (d) both (a) and (b)
Ans. (a)equally spaced.

48. If $f(0) = 12$, $f(3) = 6$, and $f(4) = 8$, then the differential of interpolation function $f(x)$ is

    (a) $x^2 - 2x + 12$ (b) $2x - 5$ (c) $3x^2 - 2x - 5$ (d) $2x - 5$
    Ans. (d) $2x - 5$
    Hints: $f(x) = x^2 - 5x + 12$, then, $f(0) = 12$, $f(3) = 6$ and $f(4) = 8$.

49. differentiation based Lagrange interpolation formula, the interval should be

    (a) equally spaced (b) not equally spaced (c)both (a) and (b) (d) none of these
    Ans. (c)both (a) and (b).

50. If $(n+1)$ values of $f(x)$ are given, then $f'(x)$ can be approximate by a polynomial of degree

    (a) n (b) $n-1$ (c) $n+1$ (d) none of these
    Ans. (b) $n-1$.

51. In differentiation based Newton's forward interpolation formula, the value of $\frac{x-x_0}{h}$ lies between

    (a) 1 and 2 (b) -1 and 1 (c)0 and ∞ (d) 0 and 1
    Ans. (d) 0 and 1.

52. The differentiation based Newton's forward interpolation formula is used to interpolate

    (a) near end (b) near central position (c) near beginning (d) none of these
    Ans. (c) near beginning.

53. The differentiation based Newton's backward interpolation formula is used to interpolate

    (a) near end (b) near central position (c) near beginning (d) none of these
    Ans. (a) near end.

54. In differentiation based Newton's backward interpolation formula, the value of $\frac{x-x_n}{h}$ lies between
    (a) -1 and 0 (b) -1 and 1 (c)0 and ∞ (d) 0 and 1
    Ans. (a) -1 and 0.

55. In differentiation based Newton's backward interpolation formula, the value of $\frac{x-x_n}{h}$ lies between

(a) -1 and 0 (b) -1 and 1 (c)0 and ∞ (d) 0 and 1
Ans. (a) -1 and 0.

56. The differentiation based Gauss's interpolation formula is used to interpolate

(a) near end (b) near central position (c) near beginning (d) none of these
Ans. (b) near central position.

57. If $y = f(x)$ are known only at $(n+1)$ distinct interpolating points then the differential of Lagrange polynomial has degree

(a) at most $(n-1)$ (b) at most n (c) exactly $n-1$ (d) exactly n.
Ans. (a) at most $(n-1)$.

58. In Simpson's 1/3 rule the portion of the curve in the interval $[x_{i-1}, x_{i+1}]$ is replaced by **CS-312-12**
(a) straight line (b) parabola (c) hyperbola (d) a cubic polynomial
Ans. (b) By Simpson 1/3 rule

$$\int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big]$$

Which represents the area of the parabola bounded by the curve $y = f(x)$, x axis and the ordinates $x = x_0, x = x_2$.

59. Find the percentage error $\int_0^{\pi} \cos^2 x dx$ by Trapezoidal rule, taking 6 subintervals.**GATE-11**
(a) 2.3% (b) 7.4% (c) 0.0% (d) 1.10%
Ans. (c) 0.0%
Hint.:

x	0	$\frac{\pi}{6}$	$\frac{2\pi}{6}$	$\frac{3\pi}{6}$	$\frac{4\pi}{6}$	$\frac{5\pi}{6}$	π
y	1	$\frac{3}{4}$	$\frac{1}{4}$	0	$\frac{1}{4}$	$\frac{3}{4}$	1

By Trapezoidal rule

$$\begin{aligned} I_T &= \int_a^b f(x)dx = \frac{h}{2}\Big[y_0 + y_n + 2(y_1 + y_2 \cdots + y_{n-1})\Big] \\ &= \frac{\pi}{2\times 6}\Big[1 + 1 + 2(\frac{3}{4} + \frac{1}{4} + 0 + \frac{1}{4} + \frac{3}{4})\Big] = \frac{\pi}{2} \end{aligned}$$

Again $\int_0^{\pi} \cos^2 x dx = 2.\frac{1}{2}.\frac{\pi}{2} = \frac{\pi}{2}$.
Therefore $E_p = \frac{V_T - V_A}{V_T} = \frac{\frac{\pi}{2} - \frac{\pi}{2}}{\frac{\pi}{2}} \times 100\% = 0\%$

60. Find the numerical value obtained by applying the two-points trapezoidal rule the integral $\int_0^1 \frac{ln(1+x)}{x} dx$ **GATE(MA)-10**
(a) $\frac{1}{3}\Big[2 + ln2\Big]$ (b) $\frac{1}{2}\Big[1 + ln5\Big]$ (c) $\frac{1}{12}\Big[1 + ln3\Big]$ (d) $\frac{1}{2}\Big[1 + ln2\Big]$.
Ans. (d) $\frac{1}{2}\Big[1 + ln2\Big]$.

Hint. Here, $y(x) = \frac{ln(1+x)}{x}$, $x_0 = 0$ and $x_1 = 1$, so $y_0 = 1$, $y_1 = ln2$ and $h = 1$. Then by Trapezoidal rule, we have $I_T = \int_{x_0}^{x_1} y(x)dx = \frac{h}{2}\Big[y_0 + y_1\Big] = \frac{1}{2}\Big[1 + ln2\Big]$.

61. The integral $\int_1^1 |x|dx$ is computed by the trapezoidal rule with step length $h = 0.01$. Then find the absolute error in the computed value **GATE-11**

(a) 0 (b) 0.6 (c) 4.2 (d) 1.5
Ans. (a) 0.
Hint. : Since $|x|$ is a polynomial of x of degree 1 and the degree of precession of Trapezoidal rule is 1. So error is zero. Hence the absolute error is zero.

62. Find the value of integral $\int_0^1 \frac{x}{x^2+10}dx$ using Simpson 1/3 rule with $h = 0.5$? **JAM-10**
(a) $\frac{44}{902}$ (b) $\frac{43}{901}$ (c) $\frac{41}{902}$ (d) $\frac{40}{900}$.
Ans. (c) $\frac{41}{902}$.
Hint.

x	0	0.5	1
y	0	$\frac{2}{41}$	$\frac{1}{11}$

By Simpson$-\frac{1}{3}$ rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] \\ &= \frac{0.5}{3}\Big[0 + \frac{4\times 2}{41} + \frac{1}{11}\Big) = \frac{41}{902} \end{aligned}$$

63. Find the value of $\int_1^2 \left(\frac{1}{x}\right)dx$ computed by using Simpson 1/3 rule with a step size of $h = 0.25$
GATE-08
(a) 0.6932 (b) 0.4935 (c) 0.5532 (d) 0.3242.
Ans. (a) 0.6932.
Hint.: First we construct the following table as

x	1	1.25	1.5	1.75	2
y	1	$\frac{4}{5}$	$\frac{2}{3}$	$\frac{4}{7}$	$\frac{1}{2}$

By Simpson$-\frac{1}{3}$ rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_n} y(x)dx = \frac{h}{3}\Big[y_0 + 4(\text{odd terms}) + 2(\text{even terms}) + y_n\Big] \\ &= \frac{0.25}{3}\Big[1 + 0.5 + 4\Big(\frac{4}{5} + \frac{4}{7}\Big) + 2\Big(\frac{2}{3}\Big)\Big] = 0.6932 \end{aligned}$$

64. Let $f(x)$ be continuous with $f(0) = 1$ and $f(\frac{\pi}{4}) = \frac{1}{2}$. If Simpson 1/3 rule for $\int_0^{\frac{\pi}{4}} f(x)dx$ gives k , then find the value of $f(\frac{\pi}{8})$ **GATE-06**
(a) $\frac{6k}{\pi} - \frac{3}{8}$ (b) $\frac{6k}{\pi} - \frac{43}{81}$ (c) $\frac{6k}{\pi} - \frac{13}{28}$ (d) $\frac{6k}{\pi} - \frac{3}{5}$.

Ans. (a) $\frac{6k}{\pi} - \frac{3}{8}$.
Hint.:

x	10	$\frac{\pi}{4}$	$\frac{\pi}{4}$
y	0	$f(\frac{\pi}{8})$	$\frac{1}{2}$

By Simpson$-\frac{1}{3}$ rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] \\ \Rightarrow k &= \frac{\pi}{4 \times 3}\Big[0 + 4f\Big(\frac{\pi}{8}\Big) + \frac{1}{2}\Big] \\ \Rightarrow f\Big(\frac{\pi}{8}\Big) &= \frac{6k}{\pi} - \frac{3}{8} \end{aligned}$$

65. The Trapezoidal rule applied to $\int_1^3 f(x)dx$ gives the value 8 and Simpson-1/3 gives the value 4, then find the value of $f(2)$. **GATE-11**

(a) $f(2) = -3.2$ (b) $f(2) = -2.5$ (c) $f(2) = -1.5$ (d) $f(2) = -2$.
Ans. (d) $f(2) = -2$.

Hint. Given that

x	1	2	3
y	f(1)	$f(2)$	$f(3)$

By Trapezoidal rule

$$\begin{aligned} I_T &= \int_{x_0}^{x_2} f(x)dx = \frac{h}{2}\Big[y_0 + 2y_1 + y_2\Big] \\ \Rightarrow & \quad \frac{1}{2}\Big[f(1) + 2f(2) + f(3)\Big] = 8 \qquad (3.1) \end{aligned}$$

By Simpson$-\frac{1}{3}$ rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] \\ \Rightarrow & \quad \frac{1}{3}\Big[f(1) + 4f(2) + f(3)\Big] = 4 \qquad (3.2) \end{aligned}$$

Subtracting (3.1) from (3.3), we get $f(2) = -2$.

66. For what values of α and β, the quadrature formula $\int_{-1}^{1} f(x)dx \approx \alpha f(-1) + f(\beta)$ is exact for all polynomial of degree ≤ 1?. GATE/MA-09

(a) $\alpha = 1$ and $\beta = 1$ (b) $\alpha = 2$ and $\beta = 1$. (c) $\alpha = 1$ and $\beta = 3$ (d) $\alpha = 1.1$ and $\beta = 5.1$.

Ans. (a) $\alpha = 1$ and $\beta = 1$.
Hint. Since the quadrature formula $\int_{-1}^{1} f(x)dx \approx \alpha f(-1) + f(\beta)$ is exact for all polynomial of degree ≤ 1, so the formula is exact for $f(x) = 1$ and x.
So, we get,
$[\alpha + 1] = 2$
and $[-\alpha + \beta] = 0$
Solving we get, $\alpha = 1$ and $\beta = 1$.

67. Find the value of the integration $\int_1^2 \int_1^2 \frac{dxdy}{x+y}$ by Trapezoidal rule?
GATE-08
(a) $\frac{10}{48}$ (b) $\frac{17}{48}$ (c) $\frac{12}{43}$ (d) $\frac{13}{38}$.
Ans. (b) $\frac{17}{48}$.
Hint. By Trapezoidal rule

$$\begin{aligned} I_T &= \int_a^b \int_c^d f(x,y)dxdy = \frac{(d-c)(b-c)}{4}\Big[f(a,d) + f(b,d) + f(a,c) + f(b,c)\Big] \\ &= \frac{1}{4}\left[\frac{1}{a+d} + \frac{1}{b+d} + \frac{1}{a+c} + \frac{1}{b+c}\right] \\ &= \frac{1}{4}\left[\frac{1}{3} + \frac{1}{4} + \frac{1}{2} + \frac{1}{3}\right] = \frac{17}{48} \end{aligned}$$

68. In evaluating $\int_a^b f(x)dx$, the error in Trapezodal rule is of order **CS-301/13**
(a) h^3 (b) h^4 (c) h^2 (d) h
Ans.(a)

69. Find the quadratic polynomial which takes the same values as f(x) at x=-1, 0, 1 and integrate it to prove that $\int_{-1}^{1} f(x)dx = \frac{1}{3}[f(-1) + 4f(0) + f(1)]$
Assuming the error to have the form $Af^{iv}(\xi), (-1 < \xi < 1)$, find the value of A.
(a) $-\frac{1}{90}$ (b) $-\frac{1}{95}$ (c)$-\frac{1}{56}$ (d) $-\frac{1}{67}$
Ans. (a) $-\frac{1}{90}$.
Hint. Since the quadratic polynomial has the same values as f(x)at x=-1, 0, 1 and the error is of the form $Af^{iv}(\xi), (-1 < \xi < 1)$. So the degree of precision is three.
Let $\int_{-1}^{1} f(x)dx = [w_1 f(-1) + w_2 f(0) + w_3 f(1)]$
and the formula is exact for f(x)=1, x and x^2.
So, we get,
$[w_1 + w_2 + w_3] = 2$
$[-w_1 + w_3] = 0$
$[w_1 + w_3] = \frac{2}{3}$.
Solving we get, $w_1 = \frac{1}{3}$, $w_2 = \frac{4}{3}, w_3 = \frac{1}{3}$.
Since the error is of the form $Af^{iv}(\xi), (-1 < \xi < 1)$. So, $Af^{iv}(\xi) = \int_{-1}^{1}(x+1)(x-0)(x-1)(x-2)\frac{f^{iv}}{24}dx$
$\Rightarrow Af^{iv}(\xi) = -\frac{f^{iv}}{90}dx$
$\therefore A = -\frac{1}{90}$.

70. Simpson's rule for integration gives exact result when $f(x)$ is a polynomial of degree :

UT-07, 09, GATE-04
(a) 1 (b) 2 (c)3 (d) 4
Ans. (c) since the degree of precision of Simpson's rule is 3. So up to third degree polynomial it gives exact result.

71. The number of sub intervals needed to obtained results correct up to 3 decimal places in evaluating $\int_0^1 e^{-x}dx$ by Trapezoidal rule is **GATE-05**
(a)8 (b) 10 (c) 12 (d) 13
Ans. (d) Here $E_T \le \frac{1}{2}10^{-3}$ and $\frac{h^3}{12}f''(\xi) \le \frac{1}{2}10^{-3} \Rightarrow h \le 0.0774e \Rightarrow \frac{1-0}{n} \le 0.07746 \Rightarrow n \approx 13$.

72. The minimum number of equal length subintervals needed to appropriate $\int_1^2 xe^x dx$ to an accuracy of at least $\frac{1}{2}10^{-6}$ using Trapezoidal rule **GATE-08**
(a) 1000e (b) 1000 (c) 100e (d) 100
Ans. (a) Here $E_T \le \frac{1}{2}10^{-6}$ and $\frac{h^3}{12}f''(\xi) \le \frac{1}{2}10^{-6} \Rightarrow h \approx 1000e$

73. The accuracy of Simpson 1/3 integration formula for a step size h is **UT-03, 06, 08, 09 GATE-06**
(a) $O(h^2)$ (b) $O(h^3)$ (c) $O(h^4)$ (d) $O(h)$
Ans. (a)

74. The value of $\int_0^1 (x^3 + 3x + 2013)dx$, $n = 200$, Which of the following give better result
(a) Simpson 1/3 (b) Trapezoidal (c) both Simpson 1/3 and Trapezoidal (d) None
Ans. (a) This is a 3rd degree polynomial so by Simpson 1/3 rule give exact result.

75. The degree of precision of Simpson 1/3rd rule is **CS-301/13**
(a)3 (b)1 (c) 2 (d) 4
Ans. (a)

76. The degree of precision of Trapezodal rule is
(a)3 (b)1 (c) 2 (d) 4
Ans. (b)

77. The value of $\int_0^1 (x^2 + 2x + 1)dx$, $n = 200$, using Simpson 1/3 rule
(a) 2.33 (b) 2.98 (c) not determinable (d) None
Ans. (a) This is a second degree polynomial so the error term is zero. Hence Approximate vale and Exact value are same. So exact value can be obtained by ordinary integration.

78. The value of $\int_0^1 (x + 2013)dx$, $n = 200$, Which of the following give better result
(a) Simpson 1/3 (b) Trapezoidal (c) both Simpson 1/3 and Trapezoidal (d) None
Ans. (c) This is a one degree polynomial. Since degree of precision of Simpson 1/3 and Trapezoidal are 3 and 1 respectively. So both methods gives exact results.

79. The exact solution of the integral $\int_0^4 (x^2 - 4)dx$ is denoted by I_E. The same integral evaluated numerically by the trapezoidal rule and Simpson's 1/3 rule are denoted by I_T and I_S respectively. The subinterval used in the numerical methods is $h = 2$. Then **GATE-11**

(a)$I_E = I_S > I_T$ (b))$I_E = I_S < I_T$ (c)$I_E < I_S < I_T$ (d))$I_E > I_S > I_T$
Ans. (a) This is a 2nd degree polynomial, so only Simpson 1/3 rule give exact result.

80. The estimate of $\int_{0.5}^{1.5} \frac{dx}{|x|}$ obtained using Simpson's 1/3 rule with three-point function evaluation exceeds the next value by **GATE(CE)-12**
(a) 0.235 (b) 0.068 (c) 0.024 (d) 0.012
Ans.(d)

x	0.5	1	1.5
y	2	1	$\frac{2}{3}$

By Simpson$-\frac{1}{3}$ rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] \\ \Rightarrow & \quad \frac{0.5}{3}\Big[2 + 4 \times 1 + \frac{2}{3}\Big] = 0.012 \end{aligned}$$

81. The value of the integral $\int_0^1 \frac{ln(1+x)}{x} dx$ with step length 0.5 by Simpson 1/3 rule is **GATE(MA)-10**
(A) $\frac{1}{6}(1 + 8log(1.5) + ln2)$ (B) $\frac{1}{6}(4log(1.5) + ln2)$
(C) $\frac{1}{6}(-48log(1.5) + ln2)$ (D) $\frac{1}{6}(1 - 8log(1.5) + ln2)$
Ans. (A)

$$\begin{aligned} \text{Here } y(x) &= \frac{1}{x}\Big(x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots +\Big) = 1 - \frac{x}{2} + \frac{x^2}{3} - \cdots + \\ \Rightarrow y(0) &= 1 \end{aligned}$$

By Simpson 1/3 rule

$$\begin{aligned} I_S &= \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] = \frac{0.5}{3}\Big[1 + 4\frac{ln(1.5)}{0.5} + ln2\Big] \\ &= \frac{1}{6}\Big[1 + 8ln(1.5) + ln2\Big] \end{aligned}$$

82. Let $f \in \mathbb{C}[a, b]$. write down Simpson's one third rule to approximate

$$\int_a^b f(x)dx$$

using the points $x = a, x = (a + b)/2$ and $x = b$. **NBHM-13**
Sotution: By Simpson 1/3 rule

$$I_S = \int_{x_0}^{x_2} y(x)dx = \frac{h}{3}\Big[y_0 + 4y_1 + y_2\Big] = \frac{1}{3}\Big[f(a) + 4f(\frac{a+b}{2}) + f(c)\Big]$$

83. The bisection method is applied to compute a zero of the function $f(x) = x^4 - x^3 - x^2 - 4$ in the interval $[1, 9]$. The method converges to a solution after how many iterations?

GATE-12
(a) 2 (b) 1 (c) 3 (d)5.
Ans. (c) 3.
Hint. Let $f(x) = x^4 - x^3 - x^2 - 4$. Since a real root lies in [1,9]. Let $x_0 = 1, x_2 = 9$.
Bisection method the iterative formula is

$$x_3 = \frac{x_1 + x_2}{2}$$

The next iterative calculation are shown in computational table.

n	x_1	x_2	$\frac{x_1+x_2}{2}$	$f(x_1)$	$f(x_2)$	$f\left(\frac{x_1+x_2}{2}\right)$
1	1	9	5	-5	5747	471
2	1	5	3	-5	471	41
3	1	3	2	-5	41	0

Hence after third iteration the Bisection method is converges to a solution.

84. What is the root of the equation $xe^x = 1$ between 0 and 1, obtained using two iterations of bisection method? **GATE(MA)-12**

(a) 0.65 (b) 0.15 (c) 1.3 (d)0.75.
Ans. (d) 0.75.
Hint. Let $f(x) = xe^x - 1$. Since a real root lies in $[0, 1]$. Let $x_1 = 0, x_2 = 1$.
Using Bisection method, the iterative formula is

$$x_3 = \frac{x_1 + x_2}{2} = \frac{0 + 1}{2} = 0.5$$

The next iterative calculation are shown in computational table.

n	x_1	x_2	$\frac{x_1+x_2}{2}$	$f(x_1)$	$f(x_2)$	$f\left(\frac{x_1+x_2}{2}\right)$
1	0	1	0.5	-1.0	1.718	-0.153
2	0.5	1	0.75	-0.153	1.718	0.041

Hence, by using Bisection method after two iteration the root is 0.75.

85. Let M be the length of the initial interval $[a_0, b_0]$ containing a solution of $f(x) = 0$. The $\{x_0, x_1, \cdots, x_n\}$ represent the successive points generated by the Bisection method. Then find the minimum number of iteration required to generate an approximation to the solution with accuracy ϵ. **GATE-08**
(a) $n < -1 - \frac{log(\frac{\epsilon}{M})}{log2}$ (b) $n > -1 - \frac{log(\frac{\epsilon}{M})}{log2}$
(c) $n < -2 - \frac{log(\frac{\epsilon}{M})}{log2}$ (d) $n > -2.1 - \frac{log(\frac{\epsilon}{M})}{log2}$
(a) $n < -1 - \frac{log(\frac{\epsilon}{M})}{log2}$.

Hint. From the equation (**??**)

$$
\begin{aligned}
& \epsilon < \frac{b_0 - a_0}{2^{n+1}} \quad \text{(Taking log in both sides)} \\
\Rightarrow \quad & log\epsilon < \frac{log(b_0 - a_0)}{(n+1)log2} \quad \text{(Given that } \; M = b_0 - a_0) \\
\Rightarrow \quad & n + 1 < \frac{log(\frac{M}{\epsilon})}{log2} \\
\Rightarrow \quad & n < -1 - \frac{log(\frac{\epsilon}{M})}{log2}
\end{aligned}
$$

86. Solution of the variables x_1 and x_2 for the following equations is to be obtained by employing the Newton-Raphson iteration method. **GATE(EE)-11**
Solution:

$$
\begin{aligned}
10x_2 sinx_1 - 0.8 &= 0 \qquad (3.3) \\
10x_2^2 - 10x_2 cosx_1 - 0.6 &= 0 \qquad (3.4)
\end{aligned}
$$

Assuming the initial value $x_1 = 0.0$ and $x_2 = 1.0$, the jacobian matrix is

(A) $\begin{pmatrix} 10 & -0.8 \\ 0 & -0.6 \end{pmatrix}$ (B) $\begin{pmatrix} 10 & 0 \\ 0 & 10 \end{pmatrix}$ (C) $\begin{pmatrix} 0 & -0.8 \\ 10 & -0.6 \end{pmatrix}$ (D) $\begin{pmatrix} 10 & 0 \\ 10 & -10 \end{pmatrix}$ **Ans.** (A)
Hint. Let $\Phi = 10x_2 sinx_1 - 0.8$ and $\Psi = 10x_2^2 - 10x_2 cosx_1 - 0.6$. Therefore

$$
J = \begin{vmatrix} \left(\frac{\partial \Phi}{\partial x_1}\right)_{x_1=0} & \left(\frac{\partial \Phi}{\partial x_2}\right)_{x_2=1} \\ \left(\frac{\partial \Psi}{\partial x_1}\right)_{x_1=0} & \left(\frac{\partial \Psi}{\partial x_2}\right)_{x_2=1} \end{vmatrix} = \begin{vmatrix} 10 & -0.8 \\ 0 & -0.6 \end{vmatrix}
$$

87. The rate of convergence of secant method is **CS-312/12**
(a) 2 (b) 1 (c) 0.62 (d)1.618
Ans. (d)

88. Which of the following does not always guarantee convergence? **CS-312/12**
(a) bisection (b) Newton-Rapshon (c) Regula Falsi (d)None of these
Ans. (b)

89. In the method of iteration the function $\phi(x)$ must satisfy **UT-06, GATE-06**
(a) $|\phi'(x)| = 1$ (b) $|\phi'(x)| > 1$ (c) $|\phi'(x)| < 1$ (d)$|\phi'(x)| = 2$
Ans. (c)

90. Regula- Falsi method is used to **UT-02**
(a) Solve the differential equation of boundary value problem
(b) Solve transcendental equation numerically
(c) Solve a system of equation numerically
(d)None of these
Ans. (b)

91. The condition of convergent of Newton Rapshon method when applied to an equation $f(x) = 0$ in an interval is **UT-07, 08**
(a) $f'(x) = 0$ (b) $f'(x) < 1$ (c) $|f'(x)|^2 > |f(x)f''(x)|$ (d)$|f''(x)|^2 < |f(x)f'(x)|$
Ans. (c) Let $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} = \phi(x_n)$ (say). The Method is convergent if $|\phi'(x_n)| < 1 \Rightarrow |f'(x)|^2 > |f(x)f''(x)|$.

92. In the equation $x^3 - x^2 + 4x - 4 = 0$ to be solved by Newton Raphson method. If $x = 2$ taken as the initial approximation of the solution, then the next approximation using this method will be **GATE-07**
(a) $\frac{2}{3}$ (b) $\frac{4}{3}$ (c) 1 (d)$\frac{3}{2}$

Ans. (b) $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 2 - \frac{2^3-2^2+4\times2-4}{3\times2^2-2\times2+4} = \frac{4}{3}$

93. Let $x^2 - 117 = 0$. The iterative steps for the solution for the solution using Newton Rapshon's method is given by **GATE(EE)-10**
(a) $x_{k+1} = \frac{1}{2}(x_k + \frac{117}{x_k})$ (b) $x_{k+1} = \frac{1}{2}(x_k - \frac{117}{x_k})$ (c) $x_{k+1} = (x_k + \frac{117}{x_k})$ (d)$x_{k+1} = (x_k - \frac{117}{x_k})$
Ans. (a) $x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)} = x_k - \frac{x_k^2-117}{2x_k} = \frac{1}{2}(x_k + \frac{117}{x_k})$

94. Let $x^2 - 117 = 0$. Newton-Rapshon method is used to compute a root of the equation $x^2 - 13.0 = 0$ with 3.50 as the initial value. After one iteration, the approximation of the root is

GATE(CS)-10
(a)3.607 (b) 3.575 (c)3.676 (d) 3.667
Ans. (a) $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = x_0 - \frac{x_0^2-13}{2x_0} = \frac{1}{2}(x_0 + \frac{13}{x_0}) = \frac{1}{2}(3.5 + \frac{13}{3.5}) = 3.607$

95. The iterative scheme $x_{n+1} = \frac{x_n}{2} + \frac{3}{x_n}$, with a positive approximation, computes

GATE(EE)-06
(a) $\sqrt{2}$ (b) $\sqrt{3}$ (c) $\sqrt{5}$ (d) $\sqrt{6}$
Ans. (b) Let $x^2 - 3 = 0$, then $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} = x_n - \frac{x_n^2-3}{2x_n} = \frac{x_n}{2} + \frac{3}{x_n}$

96. The error in the Trapezoidal rule with sub-interval 5 for $\int_5^{10} f(x)dx$ is

(a) $-\frac{5}{12}f''(\xi)$ (b) $-\frac{1}{12}f''(\xi)$ (c) $-\frac{5}{90}f''''(\xi)$ (d)$-\frac{9}{12}f''(\xi)$
Ans. (b) Here $h = \frac{(b-a)}{n} = \frac{(10-5)}{5} = 1$, Error $= -\frac{h^3}{12}f''(\xi) = -\frac{1}{12}f''(\xi)$

97. In iteration method $[x = \phi(x)]$ for the equation $\pi x = sinx$, the appropriate choice of $\phi(x)$ such that the sequence $x_0, x_1, \cdots, x_n$ converges to the root is **CS-312/11**
(a) $\frac{sinx}{\pi}$ (b) $cosx$ (c) $\frac{cosx}{\pi}$ (d)None of these
Ans. (a)

98. In which of the following methods proper choice of initial value is very important?

GATE-08
(A) False position (B) Bisection method (C) Secant method (D) Newton-Raphson
Ans (D)

99. If the bisection method is used to find the root of $x^3 + 7x^2 - x - 7 = 0$ in the interval $[a, b]$ then a and b are **GATE-06**
(A) -6 and -4 (B) -4 and -2 (C) 0 and 2 (D) 4 and 6.
Ans. (C)

100. One root of the equation $e^x - 3x^2 = 0$ lies in the interval $(3, 4)$. The least number of iteration of the bisection method so that $|error| < 10^{-3}$ is **GATE(MA)-01**
(A) 10 (B) 8 (C) 6 (D) 4
Ans.(D) Number of iteration in Bisection method

$$n \geq \frac{log(\frac{b-a}{\epsilon})}{log2}$$

Here $\epsilon = 10^{-3}$, $b - a = 1$. Therefore $n \geq \frac{3log(10)}{log2} \Rightarrow n \geq 4.8 \Rightarrow \min(n) = 4$

101. Consider the series $x_{n+1} = \frac{x_n}{2} + \frac{9}{8x_n}$, $x_0 = 0.5$ obtained from the Newton-Rapshon method. The series converges to
(A) $\sqrt{2.5}$ (B) $\sqrt{2}$ (C) 1.6 (D) 1.4.
Ans. (A)

102. Which of the following statements is/ are false? **CS-312/12**
A. Gaussian elimination method is a direct method B. Gaussian elimination method has a computational complexity $O(n^3)$ C. Gaussian elimination method solves any system of linear simultaneous equations D. Gaussian elimination method reduces the coefficient matrix in upper triangular form.
(a) C only (b) both B. and C. (c) B. only (d) all are true.
Ans. (b)

103. Which one of the following is an iterative method? **CS-312/09**
(a)Gauss- elimination (b) Gauss- Jordon (c) Gauss- Seidal (d)none of these
Ans. (c)

104. Gaussian elimination method does not fail even if one of the pivotel element is equal to zero **CS-312/02, 04, 06**
(a) True (b) False
Ans. (b)

105. In Gaussian elimination method, the given system of equations represented by $AX = B$ is converted to another system $UX = Y$, where U is ? **CS-312/08, 09**
(a) diagonal matrix (b)null matrix (c) identity matrix (d) upper triangular matrix.
Ans. (d)

106. One of the iterative methods by which we can find the solution of simultaneous system of linear equations is **MCA-10**
(a) Gauss Elimination Method (b)Gauss-Jordan Method
(c) Gauss-Seidel Method (d)LU Factorization.
Ans. (c)

107. The convergence condition for Gauss-Seidel iterative method for solving a system of linear equation is **CS-312/11**
(a) The coefficient matrix is singular (b)The coefficient matrix has rank zero
(c) The coefficient matrix must be strictly diagonally dominant (d)None of these.
Ans. (c)

108. A Runge-Kutta method for numerically solving the initial value ODE

$$y' = \frac{dy}{dx} = f(x, y) \quad \text{with} \quad y(x_0) = y_0$$

is given by (for h small)

$$y_1 = y(x_0 + h) = y_0 + k$$

$$\begin{aligned} \text{Where} \quad k &= \alpha k_1 + \beta k_2 \\ k_1 &= hf(x_0, y_0) \\ k_2 &= h[f(x_0 + mh, y_0 + nk_1)] \end{aligned}$$

The objective is to determine the constants α, β, m, n such that the above formula is accurate to order 2 (that is the error is $O(h^3)$). Which of the following are correct sets of values for these constants ? **NET(MS): (June)2013**
(a) $\alpha = \frac{1}{2}, \beta = \frac{1}{2}, m = 1, n = 1$ (b) $\alpha = 2, \beta = 1, m = \frac{1}{2}, n = \frac{1}{2}$,
(c) $\alpha = \frac{1}{3}, \beta = \frac{2}{3}, m = \frac{3}{4}, n = \frac{3}{4}$, (d) $\alpha = \frac{3}{4}, \beta = \frac{1}{4}, m = 2, n = 2$
Ans. (a), (c) and (d). (Note: The three answers are correct.)

109. Using Euler's method taking step size = 0.1, the approximate value of y obtained corresponding to $x = 0.2$ for the initial value problem $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$, is **GATE/MA-12**
(A) 1.322 (B)1.122 (C) 1.222 (D) 1.110
Ans. (c)

110. Runge Kutta method has a truncation error, which is of the order **CS-4, 6, 10**
(a) h^2 (b) h^3 (c) h^4 (d) none of these.
Ans. (b)

111. For $\frac{dy}{dx} = x + y$, and $y(0) = 1$, the the value of $y(1.1)$ according to the Euler method is [taking $h = 0.1$] **CS-312/08**
(a)0.1 (b) 0.3 (c) 1.1 (d)0.9
Ans. (c) $y_1(1.1) = y_0 + hf(x_0, y_0) = 1 + 0.1(0 + 1) = 1.1$.

112. The ordinary differential equations are solved numerically by?
(a) Euler method (b)Taylor method (c) Runge-Kutta method (d) All of these.
Ans. (d)

113. Consider the initial value problem $y' = x(y + x) - 2, y(0) = 2$. Use Euler's method with step sizes $h = 0.3$ to compute approximations to $y(0.6)$ is equals to
(a)0.953 (b)0.0953 (c) 0.909 (d)-0.953
Ans.(a) The Euler method applied to the given problem gives
$y_{n+1} = y_n + hf(x_n, y_n), n = 0, 1, \cdots$. h = 0.3: $n = 0, x_0 = 0$ $y_1 = y_0 + 0.3[-2] = 2 - 0.6 = 1.4$.
$n = 1, x_1 = 0.3$. $y_2 = y_1 + 0.3[0.3(y_1 + 0.3) - 2] = 1.4 - 0.447 = 0.953$.

114. Consider the system of equations

$$5x + -y + z = 10$$
$$2x + 4y = 12$$
$$x + y + 5z = -1$$

Using Jacobi's method with the initial guess $[x^{(0)}, y^{(0)}, z^{(0)}]^T = [2.0, 3.0, 0.0]^T$ approximate solution $[x^{(2)}, y^{(2)}, z^{(2)}]^T$ after two iteration. **GATE/MA-12**

(a)$[1.64, 1.87, -1.12]^T$ (b) $[2.64, 1.70, -1.12]^T$ (c) $[2.98, 2.70, -2.12]^T$ (d) $[1.64, 5.70, -3.12]^T$.
Ans. (b) $[2.64, 1.70, -1.12]^T$.

Hint. Given matrix is

$$\begin{aligned} 5x + -y + z &= 10 \\ 2x + 4y &= 12 \\ x + y + 5z &= -1 \end{aligned}$$

Since $\sum\limits_{j=1,\, j\neq i}^{3} |a_{ij}| < |a_{ii}|$, hence the given problem can be solved by Jacobi's method. The initial guess $[x^{(0)}, y^{(0)}, z^{(0)}]^T = [2.0, 3.0, 0.0]^T$. Above equation can be written to find first approximation solution as

$$\begin{aligned} x^{(1)} &= \frac{1}{5}\Big[10 + y^{(0)} - z^{(0)}\Big] = 2.6 \\ y^{(1)} &= \frac{1}{4}\Big[12 - 2x^{(0)}\Big] = 2.0 \\ z^{(1)} &= \frac{1}{5}\Big[-1 - x^{(0)} - y^{(0)}\Big] = -1.2 \end{aligned}$$

Put the first approximations $x^{(1)} = 2.6, y^{(1)} = 2.0, z^{(1)} = -1.2$ to get second approximation solution as

$$\begin{aligned} x^{(2)} &= \frac{1}{5}\Big[10 + y^{(1)} - z^{(1)}\Big] = 2.64 \\ y^{(2)} &= \frac{1}{4}\Big[12 - 2x^{(1)}\Big] = 1.7 \\ z^{(2)} &= \frac{1}{5}\Big[-1 - x^{(1)} - y^{(1)}\Big] = -1.12 \end{aligned}$$

Approximate solution $[x^{(2)}, y^{(2)}, z^{(2)}]^T$ after two iteration is $[2.64, 1.70, -1.12]^T$.

115. Consider the system of equations

$$5x_1 + 2x_2 + x_3 = 13$$
$$-2x_1 + 5x_2 + 2x_3 = -22$$
$$-x_1 + 2x_2 + 8x_3 = 14$$

with the initial guess of the solution $[x_1^{(0)}, x_2^{(0)}, x_3^{(0)}]^T = [1, 1, 1]^T$, approximate value of the solution $[x_1^{(1)}, x_2^{(1)}, x_3^{(1)}]^T$ after one iteration by Gauss-Seidel method. **GATE/MA-11**

(a) $x_1^{(1)} = 2.0, x_2^{(1)} = -4.4, x_3^{(1)} = 1.625$ (b) $x_1^{(1)} = 2.5, x_2^{(1)} = -4.8, x_3^{(1)} = 1.825$
(c) $x_1^{(1)} = 3.0, x_2^{(1)} = -3.4, x_3^{(1)} = 4.625$ (d) $x_1^{(1)} = 1.0, x_2^{(1)} = -2.4, x_3^{(1)} = 5.625$.
Ans. (a) $x_1^{(1)} = 2.0, x_2^{(1)} = -4.4, x_3^{(1)} = 1.625$.

Hint. Given that

$$\begin{aligned} 5x_1 + 2x_2 + x_3 &= 13 \\ -2x_1 + 5x_2 + 2x_3 &= -22 \\ -x_1 + 2x_2 + 8x_3 &= 14 \end{aligned}$$

with the initial guess of the solution $[x_1^{(0)}, x_2^{(0)}, x_3^{(0)}]^T = [1, 1, 1]^T$.

Since $\sum_{j=1,\, j\neq i}^{3} |a_{ij}| < |a_{ii}|$, hence the given problem can be solved by Gauss-Seidel method. Above equation can be written as

$$\begin{aligned} x_1^{(1)} &= \frac{1}{5}\Big[13 - 2x_2^{(0)} - x_3^{(0)}\Big] = 2.0 \\ x_2^{(1)} &= \frac{1}{5}\Big[-22 + 2x_1^{(0)} - 2x_3^{(0)}\Big] = -4.4 \\ x_3^{(1)} &= \frac{1}{8}\Big[14 - x_1^{(0)} - 2x_2^{(0)}\Big] = 1.625 \end{aligned}$$

Therefore after first iteration the approximate solution root is $x_1^{(1)} = 2.0, x_2^{(1)} = -4.4, x_3^{(1)} = 1.625$.

116. Solve by Euler's method the following differential equation $\frac{dy}{dx} = x^2 + y^2, y(0) = 1$ and $h = 0.1$. Find $y(0.2)$. **GATE/MA-12**

Hint. Given that

$$f(x, y) = x^2 + y^2, y(0) = 1, h = 0.1$$

By Euler's method iterative formula is

$$\begin{aligned} y_{n+1} &= y_n + hf(x_n, y_n) \\ y_1(0.1) &= y_0 + hf(x_0, y_0) = y_0 + h(x_0^2 + y_0^2) = 1 + 0.1(0^2 + 1^2) = 1.1 \\ y_2(0.2) &= y_1 + hf(x_1, y_1) = y_1 + h(x_1^2 + y_1^2) = 1.1 + 0.1((0.1)^2 + (1.1)^2) = 1.222 \end{aligned}$$

Therefore $y(0.2) = 1.222$.

117. Least square approximation of a function gives

(a) Exact result (b) Approximate result (c) Approximate result with minimum error (d) none of these
Ans. (c) Approximate result with minimum error.

118. Least square approximation of a function fitting

(a) only a straight line (b) a polynomial of any degree (c) any curve (d) (b) and (c)
Ans. (d) (b) or (c).

119. Weierstrass theorem for least square approximation of a function suggest

(a) a polynomial of n degree (b) a straight line only (c) any curve (d) none of these
Ans. (a) a polynomial of n degree.

120. Least square approximation of a function is used for

(a) discrete data in an interval (b) continuous data in an interval (c) both (a) and (b) (d) none of these
Ans. (c) both (a) and (b).

121. The correct statement is
(a) The fitting line by least square approximation satisfy the tabulated data (b) The interpolating polynomial satisfy the tabulated data (c) both (a) and (b) (d) none of these
Ans. (b) The interpolating polynomial satisfy the tabulated data.

122. Best approximation of least square approximation of a function mean

(a) Exact result (b) Approximate result (c) Approximate result with minimum error (d) none of these
Ans. (c) Approximate result with minimum error.

123. The correct statement is
(a) The least square method is approximated the known function (b) The interpolation method is approximated the known function
(c) The least square method is approximated a function which may be given in tabular form or known explicitly over a given interval (d) none of these.

Ans. (c) The least square method is approximated a function which may be given in tabular form or known explicitly over a given interval.

124. The correct statement is

(a) The least square method is approximated a function by any degree polynomial (b) The interpolation method is approximated a function by any degree polynomial (c) The interpolation method and the least square method are both approximated a function by any degree polynomial (d) none of these

Ans. (a) The least square method is approximated a function by any degree polynomial.

125. The weight function of Legendre polynomial is
(a) $W(x) = 1$ (b) $W(x) = x$ (c) $W(x) = 1 - x$ (d) none of these
Ans. (a) $W(x) = 1$.

126. The interval of x of Legendre polynomial is
(a) $[-1, 1]$ (b) $(-1, 1)$ (c) $[0, 1]$ (d) $[-1, 1)$
Ans. (a) $[-1, 1]$.

127. The Legendre polynomial $P_n(x)$ is
(a) even if n is even (b) odd if n is even (c) even if n is odd (d) none of these
Ans. (a) even if n is even.

128. The weight function of Chebyshev's first kind polynomial is
(a) $W(x) = 1$ (b) $W(x) = x$ (c) W(x)=$\frac{1}{1-x^2}$ (d) none of these
Ans. (c) $W(x)=\frac{1}{1-x^2}$.

129. The Chebyshev's first kind polynomial $T_n(x)$ is
(a) $sin(ncos^{-1}x)$ (b) $cos(ncos^{-1}x)$ (c) $cos(nsin^{-1}x)$ (d) $sin(nsin^{-1}x)$
Ans. (b)$cos(ncos^{-1}x)$.

130. The interval of x of Chebyshev's first kind polynomial is
(a) $[-1, 1]$ (b) $(-1, 1)$ (c) $[0, 1]$ (d) $[-1, 1)$
Ans. (a) $[-1, 1]$.

131. Which is correct for Chebyshev's first kind polynomial
(a) $T_0(x) = 0$ (b) $T_1(x) = 1$ (c) $T_2(x) = 2x^2 - 1$ (d) $T_2(x) = 2x - 1$
Ans. (c) $T_2(x) = 2x^2 - 1$.

132. The Chebyshev's first kind polynomial $T_n(x)$ is
(a) even if n is even (b) odd if n is even (c) even if n is odd (d) none of these
Ans. (a) even if n is even.

133. The Chebyshev's first kind polynomial $T_n(x)$ is a polynomial of degree
(a) n (b) $n - 1$ (c) $2n$ (d) $2n - 1$
Ans. (a) n.

134. The coefficient of x^n of Chebyshev's first kind polynomial $T_n(x)$ is
(a) 2^n (b) 2^{n-1} (c) $2n$ (d) $2n^2 - 1$
Ans. (b) 2^{n-1}.

135. Which is the orthogonal polynomial?
(a) Lagrange polynomial (b) Chebychev polynomial (c) Newton interpolation

polynomial (d) none of these
Ans. (b) Chebychev polynomial.

Chapter 4

Metric Space

4.1 Introduction

4.2 Multiple Choice Questions(MCQ)

1. Let d_1, d_2 and d_3 be metrics on a set X with at least two elements. Which of the following is NOT a metric on X? **Gate(MA): 2014**
(a) Min $\{d_1, 2\}$ (b) Max $\{d_2, 2\}$ (c) $\frac{d_3}{1+d_3}$ (d) $\frac{d_1+d_2+d_3}{3}$.
Ans. (b)

2. Let d_1, d_2 be the following metrics on $\mathbb{R}^n$ where $d_1(x, y) = \sum\limits_1^n |x_i - y_i|$, $d_2(x, y) = \left(\sum\limits_1^n |x_i - y_i|^2\right)^{\frac{1}{2}}$.
Then decide which of the following is a metric on $\mathbb{R}^n$. **NET(MS)(Dec.): 2016**
(a) $d(x, y) = \frac{d_1(x,y)+d_2(x,y)}{1+d_1(x,y)+d_2(x,y)}$
(b) $d(x, y) = d_1(x, y) - d_2(x, y)$
(c) $d(x, y) = d_1(x, y) + d_2(x, y)$
(d) $d(x, y) = e^{\pi} d_1(x, y) + e^{-\pi} d_2(x, y)$
Ans. (a), (c) and (d).

3. Consider the metric $d_2(f, g) = \left(\int\limits_a^b |f(t) - g(t)|^2\right)^{\frac{1}{2}}$ and $d_\infty(f, g) = \sup\limits_{t\in[a,b]} |f(t) - g(t)|$ on the space $X = C[a, b]$ of all real values of continuous functions on $[a, b]$. Then which of the following is TRUE? **Gate(MA): 2009**
(a) Both (X, d_2) and $((X, d_\infty)$ are complete.
(b) (X, d_2) is complete but $((X, d_\infty)$ is not complete.
(b) (X, d_∞) is complete but $((X, d_2)$ is not complete.
(d) Both (X, d_2) and $((X, d_\infty)$ are not complete.
Ans. (a).

4. Which of the following is / are true? **NET(MS)(Jun): 2016**
(a) $(0, 1)$ with the usual topology admits a metric which is complete
(b) $(0, 1)$ with the usual topology admits a metric which is not complete
(c) $[0, 1]$ with the usual topology admits a metric which is not complete

(d) $[0, 1]$ with the usual topology admits a metric which is complete.
Ans. (b) and (c).

5. Consider the smallest topology τ on $\mathbb{C}$ in which all the singleton sets are closed. Pick each correct statement from below: **NET(MS)(Jun): 2016**
(a) $(\mathbb{C}, \tau)$ is Housdorff. (b) $(\mathbb{C}, \tau)$ is compact.
(c) $(\mathbb{C}, \tau)$ is connected. (d) $\mathbb{Z}$ is dence in $(\mathbb{C}, \tau)$.
Ans. (a), (b) and (c).

6. Let A the following subset of $\mathbb{R}^2$: $\{(x, y) : (x + 1)^2 + y^2 \leq 1\} \bigcup \{(x, y) : y = x \sin \frac{1}{x}, x > 0\}$. Then **NET(MS)(Dec.): 2016**
(a) A is connected (b) A is compact
(c) A is path connected (d) A is bounded
Ans. (b) and (d).

7. Let $(\mathbb{R}, \tau)$ be a topological space with the confinite topology. Every infinite subset of $\mathbb{R}$ is
(a) Compact but not connected (b) Both compact and connected **Gate(MA): 2016**
(c) Not compact but connected (d) Neither compact nor connected
Ans. (b).

8. $f : [0, 1] \to [0, 1]$ is called shrinking map if $|f(x) - f(y) < |x - y|$ for all $x, y \in [0, 1]$ and a contraction if there exist a $\alpha < 1$ such that $|f(x) - f(y) < \alpha|x - y|$ for all $x, y \in [0, 1]$. Which of the following statements is TRUE for the function $f(x) = x - \frac{x^2}{2}$?. **Gate(MA): 2016**
(a) f is both a shrinking map and a contraction
(b) f is a shrinking map but NOT a contraction
(c) f is NOT a shrinking map but a contraction
(d) f is Neither a shrinking map NOT a contraction
Ans. (b) and (d).

9. Let d_1 and d_2 denoted the usual metric and discrete metric on $\mathbb{R}$ respectively.
Let $f : (\mathbb{R}, d_1) \to (\mathbb{R}, d_2)$ be denoted by $f(x) = x,\ x \in \mathbb{R}$. Then **Gate(MA): 2015**
(a) f is continuous but f^{-1} is NOT continuous
(b) f^{-1} is continuous but f is NOT continuous
(c) both f and f^{-1} are continuous
(d) neither f nor f^{-1} is continuous
Ans. (b)

10. If $I : \left(l^1 : \|\cdot\|_2\right) \to \left(l^2 : \|\cdot\|_1\right)$ is the identity map, then **Gate(MA): 2009**
(a) I is continuous but I^{-1} is NOT continuous
(b) I^{-1} is continuous but I is NOT continuous
(c) both I and I^{-1} are continuous
(d) neither I nor I^{-1} is continuous
Ans. (c)

11. Let X be a non-empty set. Let $\mathfrak{I}_1$ and $\mathfrak{I}_2$ be two topologies on X such that $\mathfrak{I}_1$ is strictly contained in $\mathfrak{I}_2$. If $I : (X, \mathfrak{I}_1) \to (X, \mathfrak{I}_2)$ is the identity map, then **Gate(MA): 2008**
(a) both I and I^{-1} are continuous
(b) neither I nor I^{-1} is continuous

(c) I is continuous but I^{-1} is NOT continuous
(d) I^{-1} is continuous but I is NOT continuous
Ans. (c)
Hint. Since $I(\mathfrak{I}_1) = \mathfrak{I}_1 \subset \mathfrak{I}_2$ but $I(\mathfrak{I}_2) = \mathfrak{I}_2 \subset \mathfrak{I}_1$. Hence the result.

12. Which of the following subsets of $\mathbb{R}^2$ is NOT compact? **Gate(MA): 2013**
(a) $\{(x, y) \in \mathbb{R}^2 : -1 \leq x \leq 1,\ y = \sin x\}$
(b) $\{(x, y) \in \mathbb{R}^2 : -1 \leq y \leq 1,\ y = x^8 - x^3 - 1\}$
(c) $\{(x, y) \in \mathbb{R}^2 : y = 0,\ \sin(e^{-x}) = 0\}$
(d) $\{(x, y) \in \mathbb{R}^2 : x > 0, y = \sin \frac{1}{x}\} \bigcap \{(x, y) \in \mathbb{R}^2 : x > 0, y = \frac{1}{x}\}$
Ans. (c)

13. Which of the following sets are compact ?.
(a) $\{(x, y, z) \in \mathbb{R}^3 : x^2 + y^2 + z^2 = 1$ in the Euclidean topology. **NET(MS)(Dec.): 2015**
(b) $\{(z_1, z_2, z_3) \in \mathbb{R}^3 : z_1^2 + z_2^2 + z_3^2 = 1$ in the Euclidean topology.
(c) $\prod_1^n A_n$ with product topology, where $A_n = \{0, 1\}$ has discrete topology for $n = 1, 2, 3, \cdots$.
(d) $\{z \in \mathbb{C} : |Rez \leq a|$ in the Euclidean topology for some fixed positive real number a.
Ans. (a) and (c).

14. Let G_1 and G_2 be two subsets of $\mathbb{R}^2$ and $f : \mathbb{R}^2 \to \mathbb{R}^2$ be a function. Then
(a) $f^{-1}(G_1 \bigcup G_2) = f^{-1}(G_1) \bigcup f^{-1}(G_2)$
(b) $f^{-1}(G_1^c) = (f^{-1}(G_1))^c$ **NET(MS)(Dec.): 2015**
(c) $f^{-1}(G_1 \bigcap G_2) = f^{-1}(G_1) \bigcap f^{-1}(G_2)$
(d) If G_1 is open and G_2 is closed then, $G_1 + G_2 = \{x + y : x \in G_1,\ y \in G_2$ is neither open nor closed.
Ans. (a) and (b).

15. Let f be a bounded function on $\mathbb{R}$ and $a \in \mathbb{R}$. For $\delta > 0$, $\omega(a, \delta) = \sup |f(x) - f(a)|$, $x \in (a - \delta, a + \delta)$. Then
(a) $\omega(a, \delta_1) \leq \omega(a, \delta_2)$ if $\delta_1 \leq \delta_2$
(b) $\lim\limits_{\delta \to 0^+} \omega(a, \delta) = 0$ for all $a \in \mathbb{R}$. **NET(MS)(Jun): 2015**
(c) $\lim\limits_{\delta \to 0^+} \omega(a, \delta)$ need not exist.
(d) $\lim\limits_{\delta \to 0^+} \omega(a, \delta) = 0$ if and only if f is continuous at a.
Ans. (a) and (d).

16. Consider the set $\mathbb{Z}$ of integers with the topology τ in which a subset is closed if and only if it is empty or $\mathbb{Z}$ or finite. Which of the following statement is true? **NET(MS)(Jun): 2015**
(a) τ is the subspace topology induced from the usual topology on $\mathbb{R}$
(b) $\mathbb{Z}$ is compact in the topology τ
(c) $\mathbb{Z}$ is Hausdorff in the topology τ
(d) Every infinite subset of $\mathbb{Z}$ is dence in the topology τ
Ans. (b) and (d).

17. The subspace $P = \{(x, y, z) \in \mathbb{R}^3 : z = x^2 + y^2 + 1\}$ is
(a) Compact and connected (b) Compact but not connected **Gate(MA): 2011**
(c) Not compact but connected (d) Neither compact nor connected

Ans. (c).

18. For which subspace $X \subseteq \mathbb{R}$ with the usual topology and with $\{0,1\} \subseteq X$ will a continuous function $f : X \to \{0,1\}$ satisfying $f(0) = 0$ and $f(1) = 1$ exist ? **Gate(MA): 2011**
(a) $X = [0,1]$ (b)$X = [-1,1]$ (c) $X = \mathbb{R}$ (d) $[0,1] \nsubseteq X$
Ans. (d).

19. Suppose X be a finite set of more than fives elements. Which of the following is TRUE?
(a) There is a topology on X which is T_3
(b) There is a topology on X which is T_2 but not T_3. **Gate(MA): 2011**
(c) There is a topology on X which is T_1 but not T_2.
(d) There is no topology on X which is T_1
Ans. (a).

20. The set $X = \mathbb{R}$ with the metric $d(x,y) = \frac{|x-y|}{1+|x-y|}$ is
(a) bounded but not compact (b) bounded but not complete **Gate(MA): 2010**
(c) Complete but not bounded (d) Compact but not complete
Ans. (b) and (d).

21. Let $X = N$ be equipped with the topology generated by the basis consisting of sets $A_n = \{n, n+1, n+2, \cdots\} : n \in N$. Then X is
(a) Compact and connected (b) Hausdorff and connected **Gate(MA): 2010**
(c) Hausdorff and compact (d) Neither compact not connected
Ans. (d).

22. Let $X = N \times Q$ with the subspace topology of the usual topology on $\mathbb{R}^2$ and $P = \{(n, \frac{1}{n}) : n \in N\}$. In the space X
(a) P is closed but not open (b) P is open but not closed **Gate(MA): 2010**
(c) P is both open and closed (d) P is neither open nor closed.
Ans. (d).

23. Let $X = N \times Q$ with the subspace topology of the usual topology on $\mathbb{R}^2$ and $P = \{(n, \frac{1}{n}) : n \in N\}$. The boundary of P in X is **Gate(MA): 2010**
(a) an empty set (b) a singleton set (c) P (d) X.
Ans. (d).

24. In a topological space, which of the following statements is NOT always true ?
(A) Union of any finite family of compact sets is compact. **Gate(MA): 2012**
(B) Union of any family of closed sets is closed.
(C) Union of any family of connected sets having a non empty intersection is connected.
(D) Union of any family of dense subsets is dense.
Ans. (d).

25. Consider the following statements:
P: The family of subsets $\left\{A_n = \left(-\frac{1}{n}, \frac{1}{n}\right),\ n = 1, 2, \cdots\right\}$ satisfies the finite intersection property. **Gate(MA): 2012**
Q: On an infinite set X , a metric $d : X \times X \to R$ is defined as $d(x,y) = 0,\ x = y$ and $d(x,y) = 1,\ x \neq y$.

The metric space (X, d) is compact.
R: In a Frechet (T_1) topological space, every finite set is closed.
S: If $f : R \to X$ is continuous, where R is given the usual topology and (X, τ) is a Hausdorff (T_2) space, then f is a one-one function.
Which of the above statements are correct?
(A) P and R (B) P and S (C) R and S (D) Q and S.
Ans. (c).

26. Let $X = \{a, b, c\}$ and let $\zeta = \left\{\phi, \{a\}, \{b\}, \{a, b\}, X\right\}$ be a topology defined on X. Then which of the following statements are TRUE? **Gate(MA): 2012**
$P : (X, \zeta)$ is a Hausdorff space. $Q : (X, \zeta)$ is a regular space.
$R : (X, \zeta)$ is a normal space. $S : (X, \zeta)$ is a connected space.
(A) P and Q (B) Q and R (C) R and S (D) P and S.
Ans. (b).

Chapter 5

Complex Analysis

Magnitude and Angle of a complex number: Let $z = x + iy$ be a complex number. Then magnitude of z is given by $r = |z| = \sqrt{x^2 + y^2}$ and argument of z is given by $\theta = \tan^{-1}\left(\frac{y}{x}\right)$. The principal argument of the multi-valued argument is between $-\pi$ and $+\pi$ i.e., $-\pi < \theta \leq \pi$.

Polar form of a complex number: If $x = r\cos\theta$, $y = r\sin\theta$, then $z = x + iy = r(\cos\theta + i\sin\theta) = re^{i\theta}$.

DeMoivre's Theorem: $z^n = r^n(\cos\theta + i\sin\theta)^n = r^n(\cos n\theta + i\sin n\theta)$.

Analytic functions: A function $\omega = f(z)$ is said to be analytic at a point z_0 if $f(z)$ is differentiable not only at z_0 but also at every point of some neighbourhood of z_0. A function that is analytic throughout the whole complex plane is called an entire function.

Necessary and sufficient condition for an analytic function: If $f(z) = u(x, y) + iv(x, y)$ is analytic in a domain D, then u, v satisfy the equations. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$, $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$ Provided the four partial derivatives u_x, u_y, v_x, v_y exist.

Cauchy Riemann equations: If $f(z) = u(x, y) + iv(x, y)$ be an analytic function, then

1. **Cartesian Form:** $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$ and $\frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$
2. **Polar Form:** $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}$, $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$

Milne Thomson Theorem: This method is used for finding analytic function $f(z)$ when either real or imaginary part is given.

(i) When u is given

$$\frac{\partial u}{\partial x} = \varphi_1(x, y)$$
$$\frac{\partial u}{\partial y} = \varphi_2(x, y)$$

Then $f(z) = \int \left\{\varphi_1(z, 0) - i\varphi_1(z, 0)_2\right\} dz + C$

(ii) When v is given

$$\frac{\partial v}{\partial x}=\psi_2(x,y)$$

$$\frac{\partial v}{\partial y}=\psi_1\,(x,y)$$

Then $f\,(z)=\int\left\{\psi_1\,(z,0)+i\psi_2\,(z,0)_2\right\}dz+C$

L'Hopital's Rule: For two functions g(z) and h(z) that are differentiable at z_0 andIf $g(z_0)$and $h(z_0)$ are both 0 and If $h'(z_0)$ is NOT equal to 0 then $\lim\limits_{z\to z_0}\frac{g(z)}{h(z)}=\frac{g'(z_0)}{h'(z_0)}$. Extension to this rule: if g(z), h(z), and their first n derivatives vanish at z_0, then $\lim\limits_{z\to z_0}\frac{g(z)}{h(z)}=\frac{g^{(n+1)}(z_0)}{h^{(n+1)}(z_0)}$.

Harmonic Functions: Any function satisfying Laplace's equation is said to be harmonic. Wherever a function is analytic, its real and imaginary parts are harmonic. The real and imaginary parts of harmonic functions are call conjugates of one another, i.e., $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ and $\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}=0.$

Taylor's Theorem: A function $f(z\ )$ which is analytic at all points with in a circle with center at z_0 and of radius R can be represented uniquely as a convergent power series given by $f\,(z)=a_n(z-z_0)^n$, where$a_n=\frac{f^n(z)}{n!}$.

Important Results

$\cos\theta=\frac{e^{i\theta}+e^{-i\theta}}{2}$, $\sin\theta=\frac{e^{i\theta}-e^{-i\theta}}{2i}$	$\sin i\theta=i\sinh\theta$, $\cos i\theta=i\cosh\theta$
$\cosh\theta=\frac{e^{\theta}+e^{-\theta}}{2}$, $\sinh\theta=\frac{e^{\theta}-e^{-\theta}}{2}$	$\sinh z=\frac{e^{z}-e^{-z}}{2}$, $\cosh z=\frac{e^{z}+e^{-z}}{2}$
$\sin z=\sin x\cosh y+i\cos x\sinh y$	$\sin iz=i\sinh z$, $\cos iz=i\cosh z$
$\cos z=\cos x\cosh y+i\sin x\sinh y$	$\log z=Log\ r+i\theta\ for\ (r\neq 0)$
$\log z=Log\ \lvert z\rvert+i\arg z\ \ for\ (z\neq 0)$	$e^{\log(z+i2\pi)}=z$
$\cosh^2 z-\sinh^2 z=1$	$e^z=e^{x+iy}=e^x(\cos y+i\sin y)$

Cauchy's integral theorem: If *f(z)* is analytic and single valued inside and on a simple closed contour C, then$\int_C f(z)dz=0$.
Linville Theorem: If *f(z) is continuous on a contour C of length l and if M be the upper bound of* $\lvert f(z)\rvert$ *on C, then* $\left|\oint_c f(z)\,dz\right|\le M\,l$.
Morera's theorem: If a function $f(z)$ is continuous in a domain D and such that of $\oint_G f\,(z)\,dz=0$, for every simple contour G in D , then f(z) is analytic in D.
Cauchy's integral formula: If *f(z)* is analytic within and on a closed contour C, and if a is any point within C, then $f^{(n)}(a)=\frac{n!}{2\pi i}\int_C\frac{f(z)dz}{(z-a)^{n+1}}$.
Taylor's Theorem: If f*(z)* is analytic within a circle C with its center z = a and radius R, then at every point z inside C, then $f(z)=\sum\limits_{n=0}^{\infty}a_n(z-a)^n$, where $a_n=\frac{f^n(a)}{n!}$.
Laurent' series: If *f(z)* is analytic in the closed ring bounded by two concentric circles C and C'

of centre a and radius R and R′, (R′ < R). If z is any point of the annulus, then $f(z) = \sum_{n=0}^{\infty} a_n(z-a)^n$ $+ \sum_{n=1}^{\infty} b_n(z-a)^{-n}$ where $a_n = \frac{n!}{2\pi i}\oint_C \frac{f(z)dz}{(z-a)^{n+1}}$ and $b_n = \frac{n!}{2\pi i}\oint_C \frac{f(z)dz}{(z-a)^{-n+1}}$.

Cauchy Residue theorem: If *f(z)* is analytic within and on a closed contour C, except at a finite number of poles $z_1, z_2, z_3, \cdots, z_n$ within C, then $\int_C f(z)dz = 2\pi i \sum_{r=1}^{n} Res\ (z = z_r) = 2\pi i \times (sum\ of\ residue)$.

(a) For simple pole

(i) Res (z = a) = $\lim_{z\to a}(z-a)f(z)$.

(ii) $Res(z=a) = \frac{\varphi(a)}{\psi\acute{(a)}}$ if $f(z) = \frac{\varphi(z)}{\psi(z)}$.

(b) For multiple pole

(i) $Res(z=a) = \frac{1}{(n-1)!}\frac{d^{n-1}}{dz^{n-1}}\left[(z-a)^n f(z)\right]$

(ii) $Res\,(z=a) = coefficient\ \ of\ \frac{1}{t}$ where $t = z - a$.

5.1 Multiple Choice Questions

1. If real part of an analytic faction $f(z) = u + iv$ is $u = x^2 - y^2$, then the analytic function is
   (a) $f(z) = iz^2 + c$ (b) $f(z) = -iz^2 + c$ (c) $f(z) = z + c$ (d) $f(z) = z^2 + c$.
   Ans. (d) Use Milne Thomson Formula, we have $f(z) = \int \{\varphi_1(z,0) - i\varphi_1(z,0)\}dz + C$.

2. If imaginary part of an analytic faction $f(z)$ is $v = e^x(xsiny + ycosy)$, then the analytic function is
   (a) $f(z) = ize^2 + c$ (b) $f(z) = -ize^2 + c$ (c) $f(z) = ze^z + c$ (d) $f(z) = z^2 + c$.
   Ans. (c) Use Milne Thomson Formula, we have $f(z) = \int \left\{\psi_1(z,0) + i\psi_2(z,0)_2\right\}dz + C$

3. If $\sin z = \sum_{n=0}^{\infty} a_n\left(z - \frac{\pi}{4}\right)^n$, then a_6 equals to
   (a) 0 (b) $\frac{1}{720\sqrt{2}}$ (c) $\frac{1}{720}$ (d) $-\frac{1}{720\sqrt{2}}$
   Ans. (d) Use Taylors Theorem

4. The value of $\int_{|z|=2}\left(\frac{e^{3z}}{z-1}\right)dz$
   (a) $2\pi i$ (b) $2\pi i e^3$ (c) 0 (d) $2\pi e$
   Ans. (b) Cauchy Residue theorem.

5. For the positively oriented unit circle, $\oint_{|z|=1}\frac{2Re(z)}{z+2}dz =$ GATE(MA) : 2004
   (a) 0 (b) $\pi\, i$ (c) $2\pi\, i$ (d) $4\pi\, i$
   Ans. (a)

6. The residues of a complex function $f(z) = \frac{1-2z}{z(z-1)(z-2)}$ at its poles are
   (a) $\frac{1}{2}, -\frac{1}{2}, and\ 0$ (b) $\frac{1}{2}, -\frac{1}{2}, and -1$ (c) $1, -\frac{1}{2}, and -\frac{3}{2}$ (d) $\frac{1}{2}, -\frac{1}{2}, and \frac{3}{2}$.
   Ans. (c)

7. If $f(z) = \frac{z}{8-z^3}, z = x + iy$. Then Residue of $f(z)$ at $z = 2$ is
   (a) $-\frac{1}{8}$ (b) $\frac{1}{8}$ (c) $-\frac{1}{6}$ (d) $\frac{1}{6}$ GATE(MA): 2011

Ans. (d)

8. If a function $f(z)$ is continuous in region D and if $\int_D f(z)\,dz = 0$, taken around any simple closed contour in D. Then $f(z)$ is
(a) Non-Analytic (b) Analytic (c) may or may not be Analytic (d) none of these
Ans. (b) Morera's Theorem.

9. If a function $f(z) = u(r,\theta) + iv(r,\theta)$ be analytic in region D. Then u, v are satisfied by the following equations
(a) $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}$, $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$ (b) $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}$, $\frac{\partial v}{\partial r} = \frac{1}{r}\frac{\partial u}{\partial \theta}$
(c) $\frac{\partial u}{\partial r} = -\frac{1}{r}\frac{\partial v}{\partial \theta}$, $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$ (d) $\frac{\partial u}{\partial r} = r\frac{\partial v}{\partial \theta}$, $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$

Ans. (a)

10. Let γ be the curve $r = 2 + 4\cos\theta$ $0 < \theta < \pi)$ if $I_1 = \int_\gamma \frac{dz}{z-1}$ and $I_2 = \int_\gamma \frac{dz}{z-2}$. Then
(a)$I_1 = 2I_2$ (b)$I_1 = I_2$ (c)$2I_1 = I_2$ (d)$I_1 = 0, \quad I_2 \neq 0$
Ans. (b)

11. The value $\oint_C (z-10)^{10} dz$ is equals to (where C is the contour $|z-10| = 50$)
(a) $2\pi i$ (b)$-2\pi i$ (c) $2\pi i \times 10^9$ (d) 0.
Ans. (d)

12. The value $\oint_C \frac{e^{-2z}}{(z+1)^3} dz$ is equals to (where C is the contour $|z| = 2$)
(a) $2\pi i$ (b)$-4\pi i$ (c) $4\pi i$ (d) 0.
Ans. (d)

13. The value $\oint_{|z|=2} \tan z\, dz$ is equals to
(a) $2\pi i$ (b) $-2\pi i$ (c) $4\pi i$ (d) 0.
Ans. (a)

14. The value of $\oint_{|z|=2} \left(\frac{e^z}{z} + \sin z\right) dz$ is equals to
(a) $2\pi ie$ (b) $-2\pi i$ (c) $4\pi i$ (d) 0
Ans. (d) use Cauchy Residue theorem

15. The value of $\int\limits_0^{2\pi} \frac{1}{13-5\sin\theta} d\theta$ is GATE(MA): 2004
(a)$-\frac{\pi}{6}$ (b)$-\frac{\pi}{12}$ (c)$\frac{\pi}{12}$ (d)$\frac{\pi}{6}$
Ans. (d) use the formula $\int\limits_0^{2\pi} \frac{1}{a+b\sin\theta} d\theta = \frac{2\pi}{\sqrt{a^2-b^2}}, \; a > b > 0.$

16. The poles and residue at each pole of the function f(z)=cot$z$ is
(a) nπ, $n = \pm 1, \pm 2, \cdots$ *and* $Res = 1$ (b) nπ, n=0,$\pm 1, \pm 2, \cdots$ *and* $Res = 1$
(c) nπ, n=$\pm 1, \pm 2, \cdots$ *and*$Res = 2$ (d) nπ, n=$\pm 1, \pm 2, \cdots$ *and* $Res = \pm 1$
Ans. (b) use the formula $Res(z=a) = \frac{\varphi(a)}{\psi(a)}$

17. The residue of $f(z) = \frac{ze^z}{(z-a)^3}$ at its pole is
(a) $e^a(1 + \frac{a}{2})$ (b)$e^a(1 - \frac{a}{2})$ (c)$e^a(1 + \frac{3a}{2})$ (d)$e^2(1 + \frac{a}{2})$.
Ans. (b) use the formula coefficient of $\frac{1}{t}$in $f(z)$ where$t = z - a$.

18. The integral $\oint_{|z|=2}\left(\frac{3z^2+11z-1}{z-4}\right)dz$ where C is the circle $|z|=2$ travelled clockwise is
(a) $206\pi i$ (b)$2\pi i$ (c) $6\pi i$ (d) 0
Ans. (d) use Cauchy Theorem.

19. The integral $\oint_{|z|=2}\left(\frac{\cos z}{z^3}\right)dz$ equals to
(a) $2\pi ie$ (b)$-2\pi i$ (c) πi (d)$-\pi i$
Ans. (d)use Cauchy integral formulae

20. If $I=\oint_c (z-a)^n dz = 2\pi i$,[where C is the circle with center at a of radius R if
(a) $n\neq -1$, a inside C (b) $n\neq -1$, a outside C
(c) $n=-1$, a inside C (d) $n=-1$, a outside C
Ans. (c)

21. The value of the integral $\oint_{|z|=2}\frac{\cos(2\pi z)}{(92z-1)(z-3)}dz$ where C is the circle $|z|=1$ is
(a) $-\pi i$ (b) $\frac{\pi i}{5}$ (c) $\frac{2\pi i}{5}$ (d) πi CE: 2009
Ans. (d)

22. The value of the integral $I=\oint_C\frac{\cos(\pi z)}{(z-i)^2}dz$ where C is the counter $4x^2+y^2=2$. Then, I is equal to GATE(MA): 2003
(a) 0 (b)$-2\pi\, i$ (c) $2\pi\, i\left(\frac{\pi}{\sinh^2\pi}-\frac{1}{\pi}\right)$ (d) $-\frac{2\pi^2 i}{\sinh^2\pi}$
Ans. (d)

23. The contour C in the figure is described by $x^2+y^2=16$. The value the integral $\oint\frac{z^2+8}{0.5z-1.5}dz$
(a) $-2\pi i$ (b) $2\pi i$ (c) $4\pi i$ (d) $-4\pi i$ GATE(MA): 2010
Ans. (d)

24. The value of the contour Integral $\oint_C\frac{dz}{z^2-2}$, $C:|z|=4$ is equal to
(A) $\pi\, i$ (B) 0 (C)$-\pi\, i$ (D)$2\pi i$ GATE(MA): 2000
Ans. (B)

25. Given $f(z)=\frac{z}{(z-a)^2}$ with $|z|>a$, the residue of $f(z)\,z^{n-1}$ at $z=a$ for $n\geq 0$ will be
(A) a^{n-1} (B) a^n (C) na^n (D) na^{n-1}. EE: 2008
Ans. (D)

26. The value of $\oint_C\frac{dz}{(1+z^2)}$ where C is the contour $\left|z-\frac{i}{2}\right|=1$ is
(A)$2\pi i$ (B) πi (C) $\tan^{-1}z$ (D) $\pi\tan^{-1}z$.
Ans. (B)

27. If $f(z)=c_0+c_1z^{-1}$, then $\int_{|z|=1}\frac{1+f(z)}{z}\,dz$ is given by
(A) $2\pi c_1$ (B) $2\pi(1+c_0)$ (C) $2\pi i\, c_1$ (D) $2\pi i\ (1+c_0)$.
Ans. (B).

28. The residue of the function $f(z)=\frac{1}{(z+2)^2(z-2)^2}$ at $z=2$ is
(A) $-\frac{1}{32}$ (B)$-\frac{1}{16}$ (C) $\frac{1}{16}$ (D) $\frac{1}{32}$.
Ans. (A) Since $Res(z=a)=\frac{1}{(n-1)!}\frac{d^{n-1}}{dz^{n-1}}\left[(z-a)^n f(z)\right]$.
So, $Res\,(z=2)=\frac{1}{(2-1)!}\frac{d^{2-1}}{dz^{2-1}}\left[(z-2)^2\frac{1}{(z+2)^2(z-2)^2}\right]=-1/32$.

29. For the function of a complex variable $W=\ln Z$, (where $W=u+iv$ and $Z=x+iy$) the

u =constant lines get mapped in $Z-$plane as
(A) set of radial straight lines (B) set of concentric circles
(C) set of confocal hyperbolas (D)set of confocal ellipses.
Ans. (A)

30. Let D be the semi circular contour of radius 2, then the value of the integral $\oint_D \frac{1}{(s^2+1)} ds$ is ECE : 2007
(A) $i\pi$ (B) $-i\pi$ (C)$-\pi$ (D) π.
Ans. (A) Only the poles at $s = \pm i$ lies inside the contour. $Res(s = \pm i) = \pm\frac{1}{2}$. Therefore by Cauchy Residue theorem $\int_C f(z)dz = 2\pi i \sum_{r=1}^{n} Res = 0$.

31. An analytic function of a complex variable $z = x+iy$ is expressed as $f(z) = u(x, y)+iv(x, y)$ where $i = \sqrt{-1}$. If $u = xy$, the expression for v should be

(A) $\frac{(x+y)^2}{2} + k$ (B) $\frac{x^2-y^2}{2} + k$ (C) $\frac{y^2-x^2}{2} + k$ (D) $\frac{(x-y)^2}{2} + k$.
Ans. (C)

32. If $z = x + iy$, where x and y are real. The value of $\left|e^{iz}\right|$ is
(A) 1 (B) $e^{\sqrt{x^2+y^2}}$ (C) e^y (D) e^{-y}.
Ans. (D)

33. The value of $\int \frac{\sin z}{z} dz$, where the contour of integration is a simple closed curve around the origin, is
(A) 0 (B) $2\pi i$ (C) ∞ (D)$\frac{1}{2\pi i}$.
Ans. (A)

34. The analytic function $f(z) = \frac{z-1}{z^2+1}$ has singularities at
(A)1 and -1 (B) 1 and i (C) 1 and $- - i$ (D) i and $-i$.
Ans. (D)

35. Given $i = \sqrt{-1}$, what will be the evaluation of the definite integral $\int_0^{\pi/2} \frac{\cos x+i\sin x}{\cos x-i\sin x} dx$?
(A)0 (B)2 (C)$-i$ (D) i. CS: 2011
Ans. (D) $\int_0^{\frac{\pi}{2}} \frac{e^{ix}}{e^{-ix}} dx = \int_0^{\frac{\pi}{2}} e^{2ix} dx = \left[\frac{e^{2ix}}{2i}\right]_0^{\frac{\pi}{2}} = \frac{1}{2i}\left(e^{i\pi} - 1\right) = \frac{1}{2i}(\cos\pi + i\sin\pi - 1\ ) = \frac{-2}{2i} = i$.

36. The value of $\oint_G \left(\frac{4}{z-1} - \frac{5}{z+4}\right) dz$, where G is the circle $|z| = 2$.
(a) $8\pi i$ (b) $-8\pi i$ (c) $4\pi i$ (d) 0.
Ans. (a) The point $z = -4$ lies outside $|z| = 2$, so the Cauchy–Goursat theorem shows that the second term in the integrand contributes nothing to the integral. Deforming G into any circle centered on $z = 1$ that does not contain the point $z = -4$.

37. If $f(z)$ is analytic in the entire z plane and bounded for all z, then $f(z)$ is
(a) constant (b) variable (c) not constant (d) any function of z.
Ans. (a) Liouville's theorem: If $f(z)$ is analytic in the entire z plane and bounded for all z, then $f(z)$ =constant.

38. If a function $f(z)$ is continuous in a domain D and such that of $\oint_G f(z)dz = 0$, for every simple contour G in D , then f(z) is
(a) constant (b) Analytic (c) not Analytic (d) any function of z.
Ans. (b) Morera's theorem: If a function $f(z)$ is continuous in a domain D and such that of $\oint_G f(z)dz = 0$, for every simple contour G in D, then $f(z)$ is analytic in D.

39. The product of two complex numbers $1 + i$ and $2 - 5i$ is ME: 2011
(A) $7 - 3i$ (B) $3 - 4i$ (C) $-3 - 4i$ (D) $7 + 3i$.
Ans. (A) $(1 + i)(2 - 5i) = 2 - 5i + 2i + 5 = 7 - 3i$.

40. If C is the positively oriented unit circle $|z| = 1$ and $f(z) = exp(2z)$, then $\oint_C \frac{f(z)}{z^4}dz$ is
(A) πi (B) $2\pi i$ (C) $\frac{8\pi i}{3}$ (D) $-4\pi i$.
Ans. (C)

41. The value of the integral of $\oint_C \bar{z}dz$, when C is the right-hand half $z = 2e^{i\theta}$ $\left(-\frac{\pi}{2} \leq \theta \leq -\frac{\pi}{2}\right)$ is
(A) πi (B) $2\pi i$ (C) $4\pi i$ (D) $-4\pi i$.
Ans. (C) Since $z = 2e^{i\theta}$ $\left(-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}\right)$ of the circle |z| = 2, from z = -2/ to z = 2i. Therefore $\bar{z} = 2e^{-i\theta}$ $I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \overline{2e^{i\theta}}\, d\left(2e^{i\theta}\right) = 4i \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} d\theta = 4\pi i$

42. Let C denote the positively oriented boundary of the square whose sides lie along the lines $x = \pm 2$ and $y = \pm 2$. The value of the integrals: $\oint_C \frac{\cos z}{z(z^2+8)}dz$ is
(A) $\frac{\pi i}{4}$ (B) $4\pi i$ (C) $-4\pi i$ (D) $-\frac{\pi i}{4}$.
Ans. (A)

43. The residue of $f(z) = \frac{z^3}{(z-2)(z-3)}$ at its poles at $z = 2$ and $z = 3$ respectively are
(A) 19, 12 (B) 1, 0 (C) -27, 8 (D) -8, 27.
Ans. (D). Since Res (z = a) = $\lim_{z\to a}(z - a)f(z)$, Therefore

$$\text{Res}\,(z = 2) = \lim_{z\to 2}(z-2)\frac{z^3}{(z-2)(z-3)} = -8$$

$$\text{Res}\,(z = 3) = \lim_{z\to 3}(z-3)\frac{z^3}{(z-2)(z-3)} = 27$$

.

44. The residue of $f(z) = \frac{ze^z}{(z-a)^3}$ at its pole is
(A) $\frac{\pi i}{4}$ (B) $e^a\left(\frac{a}{2} + 1\right)$ (C) $e^a\left(\frac{a}{2} - 1\right)$ (D) $e^a(a + 1)$. **Ans.** (B) Put $z = t$. $f(z) = \frac{(t+a)^3}{a^3} = \left(\frac{a}{t^3} + \frac{1}{t^2}\right)e^{(a+t)} = e^a\left(\frac{a}{t^3} + \frac{1}{t^2}\right)\left(1 + \frac{t}{1!} + \frac{t^2}{2!} + \cdots\right) = e^a\left(\frac{a}{2} + 2\right)\frac{1}{t} + (a+1)\frac{1}{t^2} + \cdots$.
The Residue at $z = a$ is coefficient of $\frac{1}{t} = e^a\left(\frac{a}{2} + 2\right)$

45. The value of the integral of $\oint_G \frac{4-3z}{z(z-1)(z-3)}dz$, where G is the circle $|z| = \frac{3}{2}$
(A) $\frac{\pi i}{4}$ (B) $2\pi i$ (C) $-4\pi i$ (D) $-\frac{\pi i}{4}$
Ans. (B).

46. The value of $\int\limits_0^{\pi} \frac{1}{12-5\cos\theta} d\theta$ is
(a) $\frac{2\pi i}{5}$ (b) $\frac{2\pi}{5}$ (c) $\frac{4\pi}{13}$ (d) 0.
Ans. (c) use the formula $\int\limits_0^{2\pi} \frac{1}{a+b\cos\theta} d\theta = \frac{2\pi}{\sqrt{a^2+b^2}}$.

47. The value of $\int_{|z|=3} \left(\frac{\cos z}{z} + \sin z \right) dz$ is
(A) $2\pi i\left(\frac{e^2}{2}+\sin 2\right)$ (B) $2\pi i\left(\frac{e^2}{2}+0\right)$ (C) $2\pi i$ (D) 0
Ans. (C)

48. The value of the contour integral $\frac{1}{2\pi i}\oint_C f(z)\,dz$ where $f(z) = \frac{z}{2}+\frac{1}{z}+\frac{2z}{z^2-1}$ and the contour C is the circle of radius 2 centered at the origin, traversed in the contour clockwise direction is
(A) 1 (B) $\frac{1}{2}$ (C) 1 (D) 3
Ans. (A) $\frac{1}{2\pi i}\oint_C f(z)\,dz = \frac{1}{2\pi i}\oint_C \left[\frac{z}{2}+\frac{1}{z}+\frac{2z}{z^2-1}\right] dz = \frac{1}{2\pi i}\oint_C \left[\frac{z}{2}\right] dz + \frac{1}{2\pi i}\oint_C \left[\frac{1}{z}+\frac{2z}{z^2-1}\right] dz$

$$= 0 + \text{Sum of Residue}$$

Now, $\frac{1}{2\pi i}\oint_C \left[\frac{z}{2}\right] dz = 0$, By Cauchy Theorem.
Since Res (z = a) = $\lim\limits_{z\to a}(z-a)f(z)$. Therefore

$$\text{Res}\,(z=0) = \lim_{z\to 0}(z-0)\frac{1}{z} = 1 \ ,$$

$$\text{Res}\,(z=1) = \lim_{z\to 1}(z-1)\frac{2z}{z^2-1} = 1$$

$$\text{Res}\,(z=-1) = \lim_{z\to 1}(z+1)\frac{2z}{z^2-1} = -1$$

49. Let $f(z) = \frac{\sin z}{z^2} - \frac{\cos z}{z}$ then
(A) f has a pole of order 2 at $z = 0$
(B) f has a simple pole at $z = 0$.
(C) $\oint_{|z|=1} f(z)\,dz = 0$, where the integral is taken anti-clockwise
(D) the residue of f at z = 0 is $-2\pi i$.
Ans. (B) Since $\lim\limits_{z\to 0} \frac{\sin z}{z} = 1$. So, $\frac{\sin z}{z^2} \equiv \frac{1}{z}$ as $z \to 0$.

50. Let $P(z), Q(z)$ be two complex non-constant polynomials of degree m, n respectively. The number of roots of $P(z) = P(z)Q(z)$ counted with multiplicity is equal to
(a) Min $\{m, n\}$ (b) Max $\{m, n\}$ (c) $m+n$ NET(MS)(Jun): 2016 (d) $m-n$.
Ans. (c).

51. The Residue of the function $f(z) = e^{-e^{\frac{1}{z}}}$ at $z = 0$ is NET(MS)(Jun): 2016
(a) $1+e^{-1}$ (b) e^{-1} (c) $-e^{-1}$ (d) $1-e^{-1}$.
Ans. (c). Since $f(z) = e^{-e^{\frac{1}{z}}} = e^{-(1+\frac{1}{1!z}+\frac{1}{2!z^2}+\cdots)}$. So the coefficient of $\frac{1}{z}$ is $-1+\frac{1}{1!}-\frac{1}{2!}+\frac{1}{3!}-\cdots$.

52. Consider the function $F(z) = \int\limits_1^2 \frac{1}{(x-z)^2} dx$, $Im(z) > 0$. Then there is a meromorphic function $G(z)$ on $\mathbb{C}$ that agree with $F(z)$ when $Im(z) > 0$, such that NET(MS)(Jun): 2016

(a) 1, ∞ are poles of $G(z)$ (b) 0, 1, ∞ are poles of $G(z)$
(c) 1, 2 are poles of $G(z)$ (d) 1, 2 are simple poles of $G(z)$.
Ans. (c) and (d).

53. Let f be a real valued harmonic function on $\mathbb{C}$, i.e., f satisfies the equation $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = 0$. Defined the functions $g = \frac{\partial f}{\partial x} - i\frac{\partial f}{\partial y}$ and $h = \frac{\partial f}{\partial x} + i\frac{\partial f}{\partial y}$. Then NET(MS)(Jun): 2015
(a) g and h are both holomorphic functions.
(b) g is holomorphic but h need not be holomorphic.
(c) h is holomorphic but g need not be holomorphic.
(d) both h and g are identically equal to the zero functions.
Ans. (b). Let $g = u + iv$ where $u = \frac{\partial f}{\partial x}$ and $v = \frac{\partial f}{\partial y}$. Also $\frac{\partial^2 f}{\partial x^2} = -\frac{\partial^2 f}{\partial y^2}$.

54. $\int_{|z+1|=2} \frac{z^2}{4-z^2} dz =$ NET(MS)(Jun): 2015
(a) 0 (b) $-2\pi i$ (c) $2\pi i$ (d) 1.
Ans. (c). Since only $z = -2$ lies within the region $|z+1| = 2$. So, $\int_{|z+1|=2} \frac{z^2}{4-z^2} dz = \int_{|z+1|=2} \Big(-1 + \frac{1}{2-z} + \frac{1}{2+z} \Big) dz = 0 + 0 + \int_{|z+1|=2} \frac{dz}{2+z} = 2\pi i$.

55. $\int_{|z-3i|=2} \frac{dz}{z^2+4} =$ GATE(MA): 2008
(a) $-\frac{\pi}{2}$ (b) $\frac{\pi}{2}$ (c) $-\frac{i\pi}{2}$ (d) $\frac{i\pi}{2}$.
Ans. (b). Since only $z = 2i$ lies within the region $|z-3i| = 2$. So, $\int_{|z-3i|=2} \frac{dz}{z^2+4} = 2\pi i \times \lim_{z\to 2i} (z - 2i) \frac{1}{z^2+4} = \frac{\pi}{2}$.

56. Let f be an entire function. Which of the following statements are correct.
(a) f is constant if the range of f is contained in a straight line. NET(MS)(Jun): 2015
(b) f is constant if f has uncountable many zeros.
(c) f is constant if f is bounded on $\{z \in \mathbb{C} : Re(z) \leq 0\}$
(d) f is constant if the real part of f is constant.
Ans. (a), (b) and (d).

57. Let p be a polynomial in 1$-$ complex variable. Suppose all zeroes of p are in the upper half plane $H = \{z \in \mathbb{C} \big| Im(z) \geq 0\}$. Then NET(MS)(Jun): 2015
(a) $Im\frac{p'(z)}{p(z)} > 0$ for $z \in \mathbb{R}$ (b) $Re\, i\frac{p'(z)}{p(z)} < 0$ for $z \in \mathbb{R}$.
(c) $Im\frac{p'(z)}{p(z)} > 0$ for $z \in \mathbb{C}$ with $Im(z) < 0$. (d) $Im\frac{p'(z)}{p(z)} > 0$ for $z \in \mathbb{C}$ with $Im(z) > 0$.
Ans. (a), (b) and (c).

58. Consider the following power series series in the complex variables z: $f(z) = \sum_{n=1}^{\infty} n \log n z^n$, $g(z) = \sum_{n=1}^{\infty} \frac{e^{n^2}}{n} z^n$. If r and R are the radii of convergence of f and g respectively, then
(a) $r = 0, R = 1$ (b) $r = 1, R = 0$ (c) $r = 1, R = \infty$ (d) $r = \infty, R = 1$.
Ans. (b). NET(MS)(Dec.): 2015

59. The bilinear transformation w which maps the points 0, 1, ∞ in the $z-$plane onto the points $-i$, $-\infty$, 1 in the $w-$plane is GATE(MA): 2003
(a) $\frac{z-1}{z+i}$ (b) $\frac{z-i}{z+1}$ (c) $\frac{z+i}{z-1}$ (d) $\frac{z+1}{z-i}$
Ans. (d). Since the bilinear transformation w which maps the points 0, 1, ∞ in the $z-$plane

onto the points $-i$, $-\infty$, 1 in the $w-$plane is give by
$\frac{(w-w_1)(w_2-w_3)}{(w_1-w_2)(w_3-w)} = \frac{(z-z_1)(z_2-z_3)}{(z_1-z_2)(z_3-z)} \Rightarrow \frac{(w-0)(1-\infty)}{(0-1)(\infty-w)} = \frac{(z+i)(\infty-1)}{(-i-\infty)(1-z)}$.

60. The bilinear transformation w which maps the points -1, 0, 1 in the $z-$plane onto the points $-i$, 1, i in the $w-$plane. Then $f(1-i)$ equals GATE(MA): 2004
(a) $-1+2i$ (b) $2i$ (c) $-2+i$ (d) $-1+i$
Ans. (c).

61. The number of zeros, counting multiplicities of the polynomial $z^5+3z^3+z^2+1$ inside the circle $|z|=2$ is GATE(MA): 2004
(a) 0 (b) 2 (c) 3 (d) 5.
Ans. (d). Let $F(z)=z^5+3z^3+z^2+1$ be the complex polynomial and the circle $|z|=2$, then zero's inside the circle are defined by $F(z)=f(z)+g(z)$, where $g(z)=z^5$ and $f(z)=3z^3+z^2+1$. Then $\left|\frac{f(z)}{g(z)}\right| \le \frac{3\cdot2^3+2^2+1}{2^5} = \frac{29}{32} < 1$. Therefore $|f(z)|<|g(z)| \Rightarrow F(z)$ has all five zero's in $|z|=2$.

62. The number of roots of the equation $z^5-12z^2+14=0$ that lie in the region $\{z \in \mathbb{C} : 2 \le |z| < \frac{5}{2}\}$ is GATE(MA): 2005
(a) 2 (b) 3 (c) 4 (d) 5.
Ans. (d). Let $g(z)=z^5$ and $f(z)=-12z^2+14$. Then $\left|\frac{f(z)}{g(z)}\right|<1$. Therefore the number of the roots of the equation is 5.

63. The bilinear transformation w which maps the points -1, i, $-i$ in the $z-$plane onto the points $1, \infty, 0$ in the $w-$plane. Then $f(1)$ is equal to GATE(MA): 2008
(a) -2 (b) -1 (c) i (d) $-i$
Ans. (b). Since the bilinear transformation $w=f(z)$ is give by
$\frac{(w-w_1)(w_2-w_3)}{(w_1-w_2)(w_3-w)} = \frac{(z-z_1)(z_2-z_3)}{(z_1-z_2)(z_3-z)}$.

64. Let $a,b,c,d \in \mathbb{R}$ be such that $ad-bc>0$. consider the Mobius Transformation $T_{a,b,c,d}(z) = \frac{az+b}{cz+d}$. Define NET(MS)(Dec.): 2015
$H_+ = \{z \in \mathbb{C} : Im(z) > 0\}$, $H_- = \{z \in \mathbb{C} : Im(z) < 0\}$.
$R_+ = \{z \in \mathbb{C} : Re(z) > 0\}$, $R_- = \{z \in \mathbb{C} : Re(z) < 0\}$.
Then, $T_{a,b,c,d}$ maps
(a) H_+ to H_+ (b) H_+ to H_- (c) R_+ to R_+ (d) R_+ to R_-.
Ans. (a).

65. Let $w(z)=\frac{az+b}{cz+d}$ and $f(z)=\frac{\alpha z+\beta}{\gamma z+\delta}$ be bilinear (Mobius) transformations. Then, the following is also a bilinear transformation GATE(MA): 2002
(a) $f(z)w(z)$ (b) $f(w(z))$ (c) $f(z)+g(z)$ (d) $f(z)+\frac{1}{w(z)}$
Ans. (b).

66. Let $f(z)=\frac{1}{e^z-1}$ for all $z \in \mathbb{C}$ such that $e^z \ne 1$. Then NET(MS)(Dec.): 2015
(a) f is meromorphic (b) the only singularities are poles
(c) f has infinitely many poles in the imaginary axis (d) each pole of f is simple
Ans. (a), (b), (c) and (d).

67. Let f be a analytic function in $\mathbb{C}$. Then f is constant if the zero set of f contains the sequence NET(MS)(Dec.): 2015
(a) $a_n=\frac{1}{n}$ (b) $a_n=(-1)^{n-1}\frac{1}{n}$ (c) $a_n=\frac{1}{2n}$ (d) $a_n=n$ if 4 does not divide n and

$a_n = \frac{1}{n}$ if 4 divides n.
Ans. (a), (b), (c) and (d).

68. Consider the function $f(z) = \frac{1}{z}$ on the annulus $A = \{z \in \mathbb{C} : \frac{1}{2} < |z| < 2\}$. Which of the following is / are true? NET(MS)(Dec.): 2015
(a) There is a sequence $p_n(z)$ of polynomials that approximate $f(z)$ uniformly on compact subsets of A.
(b) there is a sequence $r_n(z)$ of rational functions whose poles are contained in $\mathbb{C}\backslash\mathbb{A}$ and which approximate $f(z)$ uniformly on compact subsets of A.
(c) No sequence $p_n(z)$ of polynomials approximate $f(z)$ uniformly on compact subsets of A.
(d) No sequence $r_n(z)$ of rational functions whose poles are contained in $\mathbb{C}\backslash\mathbb{A}$, approximate $f(z)$ uniformly on compact subsets of A.
Ans. (b) and (c).

69. The straight lines $L_1 : x = 0$, $L_2 : y = 0$ and $L_3 : x + y = 1$ are mapped by transformation $w = z^2$ into the curves C_1, C_2 and C_3 respectively. The angle of intersection between the curves at $w = 0$ is GATE(MA): 2012
(a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) π
Ans. (c). Since $w = z^2 = (x + iy)^2$. $C_1 : w = -y^2$, $C_2 : w = x^2$ and $C_3 : w = (x + i(1 - x))^2 = -1 + 2x + 2ix(1 - x)$. So angle between curves (are C_1 and C_2) at $w = 0$ is $\frac{\pi}{2}$.

70. Let $f : \mathbb{C} \to \mathbb{C}$ be analytic except for a simple pole at $z = 0$ and let $g : \mathbb{C} \to \mathbb{C}$ be analytic. Then, the value of $\frac{\lim\limits_{z\to 0} Res\ f(z)g(z)}{\lim\limits_{z\to 0} Res\, f(z)}$ is GATE(MA): 2011
(a) $g(0)$ (b) $g'(0)$ (c) $\lim\limits_{z\to 0} zf(z)$ (d) $\lim\limits_{z\to 0} zf(z)g(z)$
Ans. (a). Since $\frac{\lim\limits_{z\to 0} Res\ f(z)g(z)}{\lim\limits_{z\to 0} Res\, f(z)} = \frac{\lim\limits_{z\to 0} zf(z)g(z)}{\lim\limits_{z\to 0} zf(z)} = \lim\limits_{z\to 0} g(z)\frac{\lim\limits_{z\to 0} zf(z)}{\lim\limits_{z\to 0} zf(z)} = g(0)$.

71. Let $u(x, y) = 2x(1 - y)$ for all real x and y. Then a function $v(x, y)$, so that $f(z) = u(x, y) + iv(x, y)$ is analytic is GATE(MA): 2010
(a) $x^2 - (y - 1)^2$ (b) $(x - 1)^2 - y^2$ (c) $(x - 1)^2 + y^2$ (d) $x^2 + (y - 1)^2$
Ans. (a).

72. Let $f(z)$ be analytic on $D = \{z \in \mathbb{C} : |z - 1| < 1\}$ such that $f(1) = 1$. If $f(z) = f(z^2)$, $\forall z \in D$, then which one of the following statements is not correct? GATE(MA): 2010
(a) $f(z) = [f(z)]^2$, $\forall z \in D$ (b) $f(\frac{z}{2}) = \frac{f(z)}{2}$, $\forall z \in D$
(c) $f(z^3) = [f(z)]^3$, $\forall z \in D$ (d) $f'(1) = 0$.
Ans. (a). Since $f(z) = f(z^2)$, $\forall z \in D$, so $f(z) \neq [f(z)]^2$, $\forall z \in D$.

73. For the function $f(z) = \sin\left(\frac{1}{\cos(\frac{1}{z})}\right)$, the point $z = 0$ is GATE(MA): 2009
(a) a removable singularity (b) a pole
(c) an essential singularity (d) a non-isolated singularity
Ans. (c). Since $f(z) = \sin\left(\frac{1}{\cos(\frac{1}{z})}\right) = 0 \Rightarrow \frac{1}{\cos(\frac{1}{z})} = n\pi,\ n \in \mathbb{Z}$.
So, $\cos(\frac{1}{z}) \to 0$ as $n \to \infty \Rightarrow z = \frac{2}{(2n+1)\pi}$, $n \in \mathbb{Z}$.
So, $\mathbb{Z} \to 0$ as $n \to \infty$. Hence $z = 0$ is an essential singularity.
Note: It is also called isolated essential singularity.

74. For the function $f(z) = \cot\left(\frac{1}{\cos(\frac{1}{z})}\right)$, the point $z = 0$ is
(a) a removable singularity (b) a pole
(c) an isolated essential singularity (d) a non-isolated essential singularity
Ans. (d). Here $f(z) = \frac{\cos\left(\frac{1}{\cos(\frac{1}{z})}\right)}{\sin\left(\frac{1}{\cos(\frac{1}{z})}\right)}$. So, $\frac{1}{f(z)} = 0 \Rightarrow \sin\left(\frac{1}{\cos(\frac{1}{z})}\right) = 0 \Rightarrow \frac{1}{\cos(\frac{1}{z})} = n\pi,\ n \in \mathbb{Z}$.
So, $\cos(\frac{1}{z}) \to 0$ as $n \to \infty \Rightarrow z = \frac{2}{(2n+1)\pi},\ n \in \mathbb{Z}$.
So, $\mathbb{Z} \to 0$ as $n \to \infty$. Hence $z = 0$ is a non- isolated essential singularity.
Note: It is note that the numerator of $f(z)$ is zero implies the isolated essential singularity, but the denominator of $f(z)$ is zero implies the non-isolated essential singularity.

75. For the function $f(z) = \tan\left(\frac{1}{\cos(\frac{1}{z})}\right)$, the point $z = 0$ is
(a) a removable singularity (b) a pole
(c) an isolated essential singularity (d) a non-isolated essential singularity
Ans. (c).

76. Let $f(z) = \sum\limits_{n=0}^{15} z^n$ for $z \in \mathbb{C}$. If $\mathbb{C} : |z - i| = 2$, then $\oint_{\mathbb{C}} \frac{f(z)dz}{(z-i)^{15}}$ is equal to GATE(MA): 2009
(a) $2\pi\, i(1 + 15i)$ (b) $2\pi\, i(1 - 15i)$ (c)$4\pi\, i(1 + 15i)$ (d) $2\pi\, i$
Ans. (a). Here $\frac{1}{2\pi\, i} \oint_{\mathbb{C}} \frac{f(z)dz}{(z-i)^{15}} = \lim\limits_{z \to i} Res f(z) = \frac{f^{14}(i)}{14!} = \frac{14!+15!i}{14!} = 1 + 15i$.

77. For the function $f(z) = \sin\frac{1}{z}$, $z = 0$ is a GATE(MA): 2002
(a) a removable singularity (b) simple pole
(c) branch point (d) an essential singularity
Ans. (d).

78. For example of a function with a non-isolated essential singularity at $z = 2$ is GATE(MA): 2003
(a) $\tan\frac{1}{z-2}$ (b) $\sin\frac{1}{z-2}$ (c) $e^{(z-2)}$ (d) $\tan\frac{1z-2}{z}$
Ans. (a). Since $\cos\frac{1}{z-2} = 0$ gives us the non-isolated essential singularity.

79. Let S be the open unit disk and $f : S \to \mathbb{C}$ be a real valued analytic function with $f(0) = 1$. Then, the set $\{z \in S : f(z) \neq 1\}$ is GATE(MA): 2008
(a) empty (b) non-empty finite (c) countably infinite (d) uncountable
Ans. (a).

80. Let $S = \{0\} \bigcup \left\{\frac{1}{4n+7} : n = 1, 2, \cdots\right\}$. Then, the number of analytic functions which vanish only on S is GATE(MA): 2007
(a) infinite (b) 0 (c) 1 (d) 2
Ans. (b). Since $\bar{S} = S$, so S is closed. If possible let $f(z)$ be analytic in $\bar{S}$. But limit point of zero's is an isolated essential singularity, so '0' can not be zero of $f(z)$. Hence, there is no such analytic function which vanish only on S. So number of analytic function is 0.

81. It is given that $\sum\limits_{n=0}^{\infty} a_n z^n$ converges at $z = 3 + 4i$. Then, the radius of convergence of the power series $\sum\limits_{n=0}^{\infty} a_n z^n$ is GATE(MA): 2007
(a) ≤ 5 (b) ≥ 5 (c) < 5 (d) > 5.

Ans. (b). Since $|z-0| \le R \Rightarrow |3+4i-0| \le R \Rightarrow R \ge 5$.

82. The principal value of $\log\left(i^{\frac{1}{4}}\right)$ is GATE(MA): 2005
(a) πi (b) $\frac{\pi i}{2}$ (c) $\frac{\pi i}{4}$ (d) $\frac{\pi i}{8}$
Ans. (d). Since $z = \frac{1}{4}\log i = \frac{1}{4}\log e^{\frac{i\pi}{2}} = \frac{\pi i}{8}$.

83. Consider the functions $f(z) = x^2 + iy^2$ and $g(z) = x^2 + y^2 + ixy$. At $z = 0$, GATE(MA): 2005
(a) f is analytic but not g (b) g is analytic but not f
(c) both f and g are analytic (d) neither f nor g is analytic
Ans. (d).

84. The coefficient of $\frac{1}{z}$ in the expansion of $\log\left(\frac{z}{z+1}\right)$, valid in $|z| > 1$ is GATE(MA): 2005
(a) -1 (b) 1 (c) $-\frac{1}{2}$ (d) $\frac{1}{2}$
Ans. (a). Since $\log\left(\frac{z}{z+1}\right) = -\log(1+\frac{1}{z}) = -\left(\frac{1}{z} - \frac{1}{2z^2} + \frac{1}{3z^3} - \cdots\right)$.

85. If D is the open unit disk in $\mathbb{C}$ and $f : \mathbb{C} \to D$ is analytic with $f(10) = \frac{1}{2}$, then $f(10+i)$ is
(a) $\frac{1+i}{2}$ (b) $\frac{1-i}{2}$ (c) $\frac{1}{2}$ (d) $\frac{i}{2}$ GATE(MA): 2004
Ans. (c). Since every entire and bounded function is constant(By Liouville's theorem).

86. The real part of the principal value of 4^{4-i} is GATE(MA): 2004
(a) $256\cos(\ln 4)$ (b) $64\cos(\ln 4)$ (c) $16\cos(\ln 4)$ (d) $4\cos(\ln 4)$
Ans. (a). Since $4^{4-i} = e^{4-i}\log 4 = e^{4\log 4} \cdot e^{-i\log 4} = 4^4\Big(\cos(\ln 4) + i\sin(\ln 4)\Big)$.

87. Consider a function $f(z) = u + iv$ defined on $|z-1| < 1$ where u, v are real-valued functions of x, y. Then, $f(z)$ is analytic for u equals to GATE(MA): 2003
(a) $x^2 + y^2$ (b) $\ln(x^2 + y^2)$ (c) e^{xy} (d) $e^{x^2-y^2}$
Ans. (b) Since $u = \ln(x^2 + y^2)$ has been satisfied by the equation $\nabla^2 u = 0$.

88. At $z = 0$, the function $f(z) = z^2\bar{z}$ GATE(MA): 2003
(a) does not satisfy Cauchy-Riemann equations
(b) satisfies Cauchy-riemann equations but is not differentiable
(c) is differentiable
(d) is analytic
Ans. (a)

89. The function $f(z) = z^2$ maps the first quadrant onto GATE(MA): 2002
(a) itself (b) upper half plane (c) third quadrant (d) right half plane
Ans. (b). Here $U = x^2 - y^2$ and $V = 2xy$. Since in the first quadrant we have $x \ge 0,\ y \ge 0$. So $v \ge 0$ but $u \le 0$ or ≥ 0.

90. The radius of convergence of the power series of the function $f(z) = \frac{1}{1-z}$ about $z = \frac{1}{z}$ is
(a) 1 (b) $\frac{1}{4}$ (c) $\frac{3}{4}$ (d) 0. GATE(MA): 2002
Ans. (c). Here $f(z) = \frac{1}{1-z} = \frac{1}{1-\frac{1}{4}-(z-\frac{1}{4})} = \frac{4}{3}\Big(1 - \frac{4}{3}(z-\frac{1}{4})\Big)^{-1} = \frac{4}{3}\Big(1 + \frac{4}{3}(z-\frac{1}{4}) + \frac{4^2}{3^2}(z-\frac{1}{4})^2 + \cdots\Big)$. So $R = \frac{3}{4}$.

91. Let T be any circle enclosing the origin and oriented counter-clockwise. Then the value of the integral $\oint_T \frac{\cos z}{z^2}dz$ is GATE(MA): 2002
(a) $2\pi i$ (b) 0 (c) $-2\pi i$ (d) undefined

Ans. (b). Since $\oint_T \frac{\cos z}{z^2} dz = 2\pi i f'(0) = -2\pi i \sin z\Big|_{z=0} = 0.$

92. The function $\sin z$ is analytic in GATE(MA): 2001
(a) $\mathbb{C}\bigcup\{\infty\}$ (b) $\mathbb{C}$ expect on the negative real axis
(c) $\mathbb{C}\bigcap\{\infty\}$ (d) $\mathbb{C}$
Ans. (d)

93. If $f(z) = z^3$, then it GATE(MA): 2001
(a) has an essential singularity at $z = \infty$ (b) has a pole of order 3 at $z = \infty$
(c) has a pole of order 3 at $z = 0$ (d) is analytic at $z = \infty$.
Ans. (b).

94. Let $\int_C \left[\frac{1}{(z-2)^4} - \frac{(a-2)^2}{z} + 4\right] dz = 4\pi$, where the close curve $\mathbb{C}$ is the triangle having vertices at i, $\frac{-1-i}{\sqrt{2}}$ and $\frac{1-i}{\sqrt{2}}$. The integral being taken in anti-clockwise direction. Then, one value of a is GATE(MA): 2012
(a) $1 + i$ (b) $2 + i$ (c) $3 + i$ (d) $4 + i$.
Ans. (c). Now, by Cauchy's integral formula, $\int_C \frac{1}{(z-2)^4} dz = 0$, $\int_C \frac{(a-2)^2}{z} dz = 2\pi i(a-2)^2$ and $\int_C 4dz = 0$. Hence we get, $0 - 2\pi i(a-2)^2 + 0 = 4\pi$. Therefore $a = 3 + i$.

95. Consider the functions $f(z) = \frac{z^2+\alpha z}{(z+1)^2}$ and $g(z) = \sinh(z - \frac{\pi}{2\alpha})$, $\alpha \neq 0$. The residue of $f(z)$ at its pole is equal to 1. Then the value of α is GATE(MA): 2012
(a) -1 (b) 1 (c) 2 (d) 3.
Ans. (d).

96. Consider the functions $f(z) = \frac{z^2+\alpha z}{(z+1)^2}$ and $g(z) = \sinh(z - \frac{\pi}{2\alpha})$, $\alpha \neq 0$. For the value of α the function $g(z)$ is not conformal at a point GATE(MA): 2012
(a) $\frac{\pi(1+3i)}{6}$ (b) $\frac{\pi(3+i)}{6}$ (c) $\frac{2\pi}{3}$ (d) $\frac{\pi i}{2}$.
Ans. (a). Since $g(z)$ is not conformal, if $g'(z) = 0 \Rightarrow \cosh(z - \frac{\pi}{6}) = 0$.

97. Let $f(z)$ be an entire function that $|f(z) \leq K|z|$, $\forall z \in \mathbb{C}$, for some $K > 0$. If $f(1) = i$, the value of $f(i)$ is GATE(MA): 2011
(a) 1 (b) -1 (c) i (d) $-i$.
Ans. (b). Let $f(z) = kz$.

98. For the function $f(z) = \frac{z}{8-z^3}$, $z = x + iy$, $\lim_{z\to 2} Res f(z)$ is GATE(MA): 2011
(a) $-\frac{1}{8}$ (b) $\frac{1}{8}$ (c) $-\frac{1}{6}$ (d) $\frac{1}{6}$.
Ans. (c).

99. The Cauchy principal value of $\int_{-\infty}^{\infty} \frac{x}{8-x^3} dx$ is GATE(MA): 2011
(a) $-\frac{\sqrt{3}\pi}{6}$ (b) $-\frac{\sqrt{3}\pi}{8}$ (c) $\pi\sqrt{3}$ (d) $-\pi\sqrt{3}$.
Ans. (a). Let, $\int_{-\infty}^{\infty} \frac{z}{8-z^3} dz$. Therefore the poles are $z = 2, -1 \pm \sqrt{3}i$. Find the Res. and use the formula.

100. Let $\oint_C \frac{f(z)}{(z-1)(z-2)}$ where $f(z) = \sin\frac{\pi z}{2} + \cos\frac{\pi z}{2}$ and C is the curve $|z| = 3$ oriented anti-clockwise. Then the value of I is GATE(MA): 2010

(a) $4\pi i$ (b) 0 (c) $-2\pi i$ (d) $-4\pi i$
Ans. (d).

101. Let $\sum\limits_{n=-\infty}^{\infty} b_n z^n$ be the Laurent series expansion of the function $\frac{1}{z\sinh z}$, $0 < |z| < \pi$. Then which one of the following is correct? GATE(MA): 2010
(a) $b_{-2} = 1$, $b_0 = -\frac{1}{6}$, $b_2 = \frac{7}{360}$ (b) $b_{-3} = 1$, $b_{-1} = -\frac{1}{6}$, $b_1 = \frac{7}{360}$
(c) $b_{-2} = 0$, $b_0 = -\frac{1}{6}$, $b_2 = \frac{7}{360}$ (d) $b_0 = 1$, $b_2 = -\frac{1}{6}$, $b_1 = \frac{7}{360}$
Ans. (a). Let $\sum\limits_{n=-\infty}^{\infty} b_n z^n = \frac{1}{z\sinh z} = \frac{2}{z(e^z - e^{-z})} = \frac{2}{2\left[(1+z+\frac{z^2}{2!}+\cdots)-(1-z+\frac{z^2}{2!}-\cdots)\right]}$.

102. Under the transformation $w = \sqrt{\frac{1-iz}{z-i}}$, the region $D = \{z \in \mathbb{C} : |z| < 1\}$ is transformed to
(a) $\{z \in \mathbb{C} : 0 < arg(z) < \pi\}$ GATE(MA): 2010
(b) $\{z \in \mathbb{C} : -\pi < arg(z) < 0\}$
(c) $\{z \in \mathbb{C} : 0 < arg(z) < \frac{\pi}{2} \text{ or } 0 < arg(z) < \frac{3\pi}{2}\}$
(d) $\{z \in \mathbb{C} : \frac{\pi}{2} < arg(z) < \pi \text{ or } \frac{3\pi}{2} < arg(z) < 2\pi\}$
Ans. (d).

103. Let $\sum\limits_{-\infty}^{\infty} a_n(z+1)^n$ be the Laurent series expansion of $f(z) = \sin(\frac{z}{z+1})$. Then a_{-2} is equal to
(a) 1 (b) 0 (c) $\cos(1)$ (d) $-\frac{1}{2}\sin(1)$. GATE(MA): 2009
Ans. (b).

104. Let $u(x, y)$ be the real part of an entire function $f(z) = u(x, y) + iv(x, y)$ for $z = x + iy \in \mathbb{C}$. If $\mathbb{C}$ is the positive oriented boundary of a rectangular region R in $\mathbb{R}^2$, then $\oint_{\mathbb{C}} \left[u_y dx - u_x dy\right]$ is equal to GATE(MA): 2009
(a) 1 (b) 0 (c) 2π (d) π.
Ans. (b).

105. For the function $f(z) = \frac{e^{iz}}{z(z^2+1)}$, the residue of f at the isolated singular point in the upper half plane $\{z = x + iy \in \mathbb{C},\ y > 0\}$ $\lim\limits_{z\to 2} Res f(z)$ is GATE(MA): 2009
(a) $-\frac{1}{2e}$ (b) $-\frac{1}{e}$ (c) $\frac{e}{2}$ (d) 1.
Ans. (a).

106. The Cauchy principal value of $\int\limits_{-\infty}^{\infty} \frac{\sin x dx}{x(x^2+1)}$ is GATE(MA): 2009
(a) $-2\pi(1 + 2e^{-1})$ (b) $\pi(1 - e^{-1})$ (c) $2\pi(1 + e)$ (d) $-\pi(1 + e^{-1})$.
Ans. (b). Since $\int\limits_{-\infty}^{\infty} \frac{\sin x dx}{x(x^2+a^2)} = \frac{\pi}{a^2}(1 - e^{-1})$.

107. Let $f(z) = \cos z - \frac{\sin z}{z}$ for non-zero $z \in \mathbb{C}$ and $f(0) = 0$. Then $f(z)$ has a zero at $z = 0$ of order
(a) 0 (b) 1 (c) 2 (d) greater than 2. GATE(MA): 2008
Ans. (c). Let us consider order m. Then find minimum value of m, for which $\lim\limits_{z\to 0} \frac{f(z)}{z^m}$ exist.

108. Let $f(z) = \cos z - \frac{\sin z}{z}$ for non-zero $z \in \mathbb{C}$ and $f(0) = 0$ and let $g(z) = \sinh z$ for $z \in \mathbb{C}$. Then $\frac{g(z)}{zf(z)}$ has a pole at $z = 0$ of order GATE(MA): 2008

(a) 1 (b) 2 (c) 3 (d) greater than 3.
Ans. (b).

109. The fixed points of $f(z) = \frac{2iz+5}{z-2i}$ are
(a) $1 \pm i$ (b) $1 \pm 2i$ (c) $2i \pm 1$ (d) $i \pm 1$ GATE(MA): 2001
Ans. (c). For fixed points, we have $f(z) = z$.

110. For the function $f(z) = \frac{1-e^{-z}}{z}$, the point $z = 0$ is GATE(MA): 2000
(a) an essential singularity (b) a pole of order zero
(c) a pole of order one (d) a removal singularity
Ans. (b) and (d).

111. The transformation $w = e^{i\theta}\left(\frac{z-\rho}{\bar{\rho}z-1}\right)$, where ρ is a constant, maps $|z| < 1$ onto GATE(MA): 2000
(a) $|w| < 1,\ |\rho| < 1$ (b) $|w| > 1,\ |\rho| > 1$ (c) $|w| = 1,\ |\rho| = 1$ (d) $|w| = 3,\ \rho = 0$
Ans. (a).

112. Let $f(z)$ be an analytic function with a simple pole at $z = 1$ and a double pole at $z = 2$ with residues 1 and -2 respectively. Further, if $f(0) = 0$, $f(3) = -\frac{3}{4}$ and f is bounded as $z \to \infty$, then $f(z)$ must be GATE(MA): 2003
(a) $z(z-3) - \frac{1}{4} + \frac{1}{z-1} - \frac{2}{(z-1)^2} + \frac{1}{(z-2)^2}$ (b) $-\frac{1}{4} + \frac{1}{z-1} - \frac{2}{(z-1)^2} + \frac{1}{(z-2)^2}$
(c) $\frac{1}{z-1} - \frac{2}{(z-1)^2} + \frac{5}{(z-2)^2}$ (d) $\frac{15}{4} + \frac{1}{z-1} + \frac{2}{z-2} - \frac{7}{(z-2)^2}$
Ans. (d). According to the problem $\lim_{z\to 1}(z-1)f(z) = 1$, $\lim_{z\to 2}\frac{d}{dx}\{(z-2)^2 f(z)\} = -2$ and $\lim_{z\to\infty} f(z)$ is bounded.

113. Let $f(z) = u(x,y) + iv(x,y)$ be an entire function having Taylor's series expansion as $\sum_{n=0}^{\infty} a_n z^n$. If $f(x) = u(x,0)$ and $f(iy) = iv(0,y)$, then GATE(MA): 2003
(a) $a_{2n} = 0,\ \forall n$ (b) $a_0 = a_1 = a_2 = a_3 = 0,\ a_4 \neq 0$ (c) $a_{2n+1} = 0,\ \forall n$ (d) $a_0 \neq 0$ but $a_2 = 0$
Ans. (a).

114. In the Laurent series expansion of $f(z) = \frac{1}{z-1} - \frac{1}{z-2}$ valid in the region $|z| > 2$, the coefficient of $\frac{1}{z^2}$ is GATE(MA): 2004
(a) -1 (b) 0 (c) 1 (d) 2
Ans. (a). Since $|z| > 2$ so, $|\frac{1}{z}| < \frac{1}{2} < 1$ and $|\frac{2}{z}| < 1$.
Therefore $f(z) = \frac{1}{z-1} - \frac{1}{z-2} = \frac{1}{z}\left[(1-\frac{1}{z})^{-1} - (1-\frac{2}{z})^{-1}\right] = -\frac{1}{z^2} - \frac{3}{z^3} - \cdots$.

115. The principal value of the improper integral $\int_{-\infty}^{\infty} \frac{\cos x}{1+x^2}dx$ is GATE(MA): 2003
(a) $\frac{\pi}{e}$ (b) πe (c) $\pi + e$ (d) $\pi - e$
Ans. (a). Since $\int_{-\infty}^{\infty} \frac{\cos mx}{a^2+x^2}dx = \frac{\pi}{a}e^{-ma}$.

116. the value of $\int_0^{2\pi} \exp(e^{i\theta} - i\theta)d\theta$ equals to GATE(MA): 2006
(a) $2\pi i$ (b) 2π (c) π (d) πi

Ans. (b).

117. Which of the following is not the real part of the analytic function? GATE(MA): 2006
(a) $x^2 - y^2$ (b) $\frac{1}{1+x^2+y^2}$ (c) $\cos x cosh y$ (d) $x + \frac{x}{x^2+y^2}$
Ans. (b). Since $\nabla^2(\frac{1}{1+x^2+y^2}) \neq 0$.

118. The radius of convergence of $\sum\limits_{n=0}^{\infty} \frac{(1+\frac{1}{n})^{n^2}}{n^3} z^n$ is GATE(MA): 2006
(a) e (b) $\frac{1}{e}$ (c) 1 (d) ∞.
Ans. (b). Since $\frac{1}{R} = \lim\limits_{z\to\infty} \left(\frac{(1+\frac{1}{n})^{n^2}}{n^3}\right)^{\frac{1}{n}} = \lim\limits_{z\to\infty} \frac{(1+\frac{1}{n})^n}{(n^{\frac{1}{n}})^3} = \frac{e}{1}$

119. The sum of the residue at all the poles of $f(z) = \frac{\cot \pi z}{(z+a)^2}$, where a is a constant, ($a \neq 0, \pm 1, \pm 2, \cdots$) is GATE(MA): 2006
(a) $\frac{1}{\pi} \sum\limits_{n=-\infty}^{\infty} \frac{1}{(n+a)^2} - \pi\, cosec^2 \pi\, a$ (b) $-\frac{1}{\pi} \sum\limits_{n=-\infty}^{\infty} \frac{1}{(n+a)^2} + \pi\, cosec^2 \pi\, a$
(c) $-\frac{1}{\pi} \sum\limits_{n=-\infty}^{\infty} \frac{1}{(n+a)^2} - \pi\, cosec^2 \pi\, a$ (d) $\frac{1}{\pi} \sum\limits_{n=-\infty}^{\infty} \frac{1}{(n+a)^2} + \pi\, cosec^2 \pi\, a$
Ans. (a). Since $f(z) = \frac{\cot \pi z}{(z+a)^2}$ has a poles at $z = -a$ of order 2 and at $z = n$, $n \in \mathbb{Z}$. So Res of $f(z)$ (at $z = -a$)$= -\pi cosec^2 \pi\, a$ and Res of $f(z)$ (at $z = n$) $= \lim\limits_{z\to n}(z-n)\frac{\cos \pi z}{\sin \pi z (z+a)^2} = \frac{i}{\pi\,(n+a)^2}$.
Hence the sum of the residue at all the poles of $f(z) = \frac{\cot \pi z}{(z+a)^2}$ is $\frac{1}{\pi} \sum\limits_{n=-\infty}^{\infty} \frac{1}{(n+a)^2} - \pi\, cosec^2 \pi\, a$.

120. Let $\mathbb{C}$ be the boundary of the triangle formed by the points $(1, 0, 0)$, $(0, 1, 0)$, $(0, 0, 1)$. Then, the value of the line integral $\oint_C -2ydx + (3x - 4y^2)dy + (z^2 + 3y)dz$ is GATE(MA): 2007
(a) 0 (b) 1 (c) 2 (d) 4
Ans. (a).

121. Let $f(z) = 2z^2 - 1$. Then the maximum value of $|f(z)|$ on the unit disc $D = \{z \in C : |z| =\leq 1\}$ equals to GATE(MA): 2007
(a) 1 (b) 2 (c) 3 (d) 4
Ans. (c).

122. Let $f(z)$ be an analytical function. Then the value of $\int\limits_0^{2\pi} f(e^{it}) \cos t dt$ equals to
(a) 0 (b) $2\pi f(0)$ (c) $2\pi f'(0)$ (d) $\pi f'(0)$ GATE(MA): 2007
Ans. (c).

123. Let G_1 and G_2 be the images of the disc $\{z \in \mathbb{C} | z + 1| < 1\}$ under the transformations $\omega = \frac{(1-i)z+2}{(1+i)z+2}$ and $\omega = \frac{(1+i)z+2}{(1-i)z+2}$ respectively. Then, GATE(MA): 2007
(a) $G_1 = \{\omega \in \mathbb{C} : Im(\omega) < 0\}$ and $G_2 = \{\omega \in \mathbb{C} : Im(\omega) > 0\}$
(b) $G_1 = \{\omega \in \mathbb{C} : Im(\omega) > 0\}$ and $G_2 = \{\omega \in \mathbb{C} : Im(\omega) < 0\}$
(c) $G_1 = \{\omega \in \mathbb{C} : Im(\omega) > 2\}$ and $G_2 = \{\omega \in \mathbb{C} : Im(\omega) < 2\}$
(d) $G_1 = \{\omega \in \mathbb{C} : Im(\omega) < 2\}$ and $G_2 = \{\omega \in \mathbb{C} : Im(\omega) > 2\}$
Ans. (b).

124. Let $f : \mathbb{C} \to \mathbb{C}$ be an arbitrary analytic function satisfying $f(0) = 0$ and $f(1) = 2$. Then,
(a) there exist a sequence $\{Z_n\}$ such that $|Z_n| > n$ and $|f(Z_n)| < n$ GATE(MA): 2007
(b) there exist a sequence $\{Z_n\}$ such that $|f(Z_n)| > n$

(c) there exist a bounded sequence $\{Z_n\}$ such that $|f(Z_n)| > n$
(d) there exist a sequence $\{Z_n\}$ such that $Z_n \to 0$ and $f(Z_n) \to 2$.
Ans. (c).

125. Let $f(z)$ be an entire function such that for some constant α, $|f(z)| \le \alpha|z|^3$ for $|z| \ge 1$ and $f(z) = f(iz)$, $\forall z \in \mathbb{C}$. Then, GATE(MA): 2006
(a) $f(z) = \alpha z^3$, $\forall z \in \mathbb{C}$ (b) $f(z)$ is constant
(c) $f(z)$ is quadratic polynomial (d) no such $f(z)$ exists.
Ans. (b). Since $f(z)$ is analytic and $|f(z)| \le \alpha|z|^3$ so, $f(z) = a_0 + a_1 z + a_2 z^2 + a_3 z^3$. Also $f(z) = f(iz) \Rightarrow a_1 = a_2 = a_3 = 0$. Therefore $f(z) = a_0$.

126. Let f be the entire function on C such that $f(z) \le 100 \log|z|$ for each z with $|z| \ge 2$. If $f(i) = 2i$ then $f(1)$ must be GATE(MA): 2013
(a) 2 (b) $2i$ (c) i (d) Cannot be determined
Ans. (b)

127. Let $\mathbb{C}$ be the contour $|z| = 2$ oriented in the anti-clockwise direction. The value of the integral $\oint_C ze^{\frac{3}{z}} dz$ is GATE(MA): 2013
(a) $3\pi i$ (b) $5\pi i$ (c) $7\pi i$ (d) $9\pi i$
Ans. (d)

128. Let $f : \mathbb{C}\{3i\} \to \mathbb{C}$ be defined by $f(z) = \frac{z-i}{iz+3}$. Which of the following statement about f is false? GATE(MA): 2013
(a) f is conformal on C
(b) f maps circles $\mathbb{C}\{3i\}$ onto circles in C.
(c) All the fixed points of f are in the region $\{z \in C : Im(z) > 0\}$
(d) There is no straight line in $\mathbb{C}\{3i\}$ which is mapped onto a straight line in C by f.
Ans. (c)

129. The image of the region $\{z \in \mathbb{C} : Re(z) > Im(z) > 0\}$ under the mapping $z \mapsto e^{z^2}$ is
(a) $\{w \in C : Re(w) > 0, Im(w) > 0\}$ (b) $\{w \in C : Re(w) > 0, Im(w) > 0, |w| > 1\}$
(c) $\{w \in C : |w| > 1\}$ (d) $\{w \in C : Im(w) > 0, |w| > 1\}$ GATE(MA): 2013
Ans. (c)

130. Let f be an analytic function on $\bar{D} = \{z \in C : |z| \le 1\}$. Assume that $|f(z)| \le 1$ for each $z \in \bar{D}$. Then, which of the following is not a possible value of $(e^f)''(0)$? GATE(MA): 2013
(a) 2 (b) 6 (c) $\frac{7e^{\frac{1}{9}}}{9}$ (d) $\sqrt{2} + \sqrt{2}$.
Ans. (b). Since $(e^f)''(0) = e'(0)[f''(0) + f'(0)^2]$.

131. The coefficient of $(z-\pi)^2$ in the Taylor series expansion of

$$f(z) = \begin{cases} \frac{\sin z}{z-\pi} & \text{if } z \ne \pi \\ -1 & \text{if} z = \pi \end{cases}$$

around π is GATE(MA): 2013
(a) $\frac{1}{2}$ (b) $-\frac{1}{2}$ (c) $\frac{1}{6}$ (d) $-\frac{1}{6}$
Ans. (c).

132. The function $f(z) = |z|^2 + i\bar{z} + 1$ is differentiable at GATE(MA): 2014

(a) i (b) 1 (c) $-i$ (d) no point in $\mathbb{C}$.
Ans. (c). Since $f(x,y) = x^2 + y^2 + i(x - iy) + 1$. check the Cauchy Riemann equations.

133. The radius of convergence of the power serious $\sum_{n=0}^{\infty} 4^{(-1)^n n} z^{2n}$ is GATE(MA): 2014
Ans. $R = \frac{1}{2}$. Since

$$a_n = \begin{cases} 0, & n = 2k-1 \\ 4^n, & n = 2k, \qquad k = 1, 2, 3, \cdots \end{cases}$$

also $\frac{1}{R} = \lim_{n\to\infty} \sup \sqrt[n]{|a_n|} = \lim_{k\to\infty} |4^k|^{\frac{1}{2k}} = 2.$

134. The maximum modulus of e^{z^2} on the set $S = \{z \in \mathbb{C} : 0 \le Re(z) \le 1,\ 0 \le Im(z) \le 1\}$ is
(a) $\frac{2}{e}$ (b) e (c) $e+1$ (d) e^2 GATE(MA): 2014
Ans. (b).

135. Let $\Omega = \{z \in \mathbb{C} : Im(z) > 0\}$ and let $\mathbb{C}$ be a smooth curve lying in Ω with initial point $-1+2i$ and final point $1+2i$. The value of $\int_C \frac{1+2z}{1+z} dz$ is GATE(MA): 2014
(a) $4 - \frac{1}{2}ln2 + i\frac{\pi}{4}$ (b) $-4 + \frac{1}{2}ln2 + i\frac{\pi}{4}$ (c) $4 + \frac{1}{2}ln2 - i\frac{\pi}{4}$ (d) $4 - \frac{1}{2}ln2 + i\frac{\pi}{4}$
Ans. (a)

136. If $a \in \mathbb{C}$ with $|a| < 1$, then the value of $\frac{(1-|a|^2)}{\pi} \int_\Gamma \frac{|dz|}{|z+a|^2}$, where Γ is the simple closed curve $|z| = 1$ taken with the positive orientation is GATE(MA): 2014
Ans. 1.99 to 2.1.

137. If the power series $\sum_{n=0}^{\infty} a_n(z + 3 - i)$ convergence at $5i$ and diverges at $-3i$, then the power series GATE(MA): 2014
(a) converges at $-2+5i$ and diverges at $2-3i$
(b) converges at $2-3i$ and diverges at $-2+5i$
(c) converges at both $2-3i$ and $-2+5i$
(d) diverges at both $2-3i$ and $-2+5i$
Ans. (a).

138. Let $u(x,y) = x^3 + ax^y + bxy^2 + 2y^3$ be a harmonic function and $v(x,y)$ its harmonic conjugate. If $v(0,0) = 1$, then $a + b + 2v(1,1)$ is equal to GATE(MA): 2016
Ans. 9.9 to 10.1.

139. Let $\{\gamma = z \in \mathbb{C} : |z| = 2\}$ be oriented in the counter-clockwise direction. Let $I = \frac{1}{2\pi i} \oint_\gamma z^7 \cos(\frac{1}{z^2}) dz$. Then the value of I is equal to GATE(MA): 2016
Ans. 0.039 to 0.043.

140. Let (Z_n) be a sequence of distinct points in $D(0,1) = \{z \in \mathbb{C} : |z| < 1\}$ with $\lim_{n\to\infty} z_n = 0$. Consider the following statements P and Q:
(P) : there exist a unique analytical function f on $D(0,1)$ such that $f(z_n) = \sin(z_n)$ for all z_n.
(Q) : there exist a unique analytical function f on $D(0,1)$ such that $f(z_n) = 0$ if n is even and $f(z_n) = 1$ if n is odd. GATE(MA): 2016
Which of the following statement hold TRUE?

(a) both P and Q (b) only P (c) only Q Neither P nor Q.
Ans. (b).

141. Consider the power series $\sum_{n=0}^{\infty} a_n z^n$ where $a_n = \begin{cases} \frac{1}{3^n}, & \text{if n is even} \\ \frac{1}{5^n}, & \text{if n is odd} \end{cases}$ The radius of convergence of the power serious is equal to GATE(MA): 2015
Ans. 3.

142. Let $C = \{z \in \mathbb{C} : |z - i| = 2\}$. Then $\frac{1}{2\pi} \int_{\mathbb{C}} \frac{z^2-4}{z^2+4} dz$ is equal to GATE(MA): 2015
Ans. -2.

143. Let Let $D = \{z \in \mathbb{C} : |z| < 1\}$. Then there exist a non-constant analytic function f on D such that for all $n = 2, 3, 4, \cdots$ GATE(MA): 2015
(a) $f(\frac{\sqrt{-1}}{n}) = 0$ (b) $f(\frac{1}{n}) = 0$ (c) $f(1 - \frac{1}{n}) = 0$ (d) $f(\frac{1}{2} - \frac{1}{n}) = 0$
Ans. c.

144. Let $\sum_{-\infty}^{\infty} a_n z^n$ be the Laurent series expansion of $f(z) = \frac{1}{2z^2-13z+15}$ in the annulus $\frac{3}{2} < |z| < 5$. Then $\frac{a_1}{a_2}$ is equal to GATE(MA): 2015
Ans. 5.

145. The value of $\frac{i}{4-\pi} \int_{|z|=4} \frac{dz}{z \cos z}$ is equal to GATE(MA): 2015
Ans. 2.

Career counseling is important in India as it helps people navigate the complexities of the Indian job market. It helps them identify potential career paths, consider their strengths and weaknesses, and make informed decisions about their future. Career guidance will help students fulfill their aspirations by setting up realistic goals. As mentioned earlier, career choice will determine the students' future by providing them with their dream job and providing them a better lot with job satisfaction. Career guidance with an expert counselor will develop a clear road map to fulfill future dreams. A career guidance counselor is an expert in career opportunities and options that students must have, depending on their interests and capability. A counselor is well aware of the opportunity and examines them from a broader perspective to find a suitable solution for a particular student. From all the details mentioned above, it must have been clear how an individual can obtain benefits from career guidance.

A student needs to develop many skills to reach their professional goal. The following link from Department of Mathematics of Mugberia Gangadhar Mahavidyalaya might help you understand those necessary skills for a better future mugberiagangadharmahavidyalaya.ac.in. Here we uploads all day by day program picture.

career counseling by the best career counselors. They will help you at each step to decide your career path. This guidance will be based entirely on understanding your innate abilities, assessed through a well-research method called DMIT. Through this guidance program, we also inform parents about all the career opportunities for their children. For any more queries, please feel free to contact us.

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