(BSM)

B.Sc. (MATHEMATICS)

INSTRUCTIONS TO CANDIDATES

1. Candidates should write their Hall Ticket Number only in the space provided at the top left hand corner of this page, on the leaflet attached to this booklet and also in the space provided on the OMR Response Sheet. **BESIDES WRITING, THE CANDIDATE SHOULD ENSURE THAT THE APPROPRIATE CIRCLES PROVIDED FOR THE HALL TICKET NUMBERS ARE SHADED USING H.B. PENCIL ONLY ON THE OMR RESPONSE SHEET. DO NOT WRITE HALL TICKET NUMBER ANY WHERE ELSE.**
2. Immediately on opening this Question Paper Booklet, check:
   (a) Whether **200** multiple choice questions are printed (**100** questions in Mathematics, **50** questions in Analytical Ability and **50** questions in Communicative English)
   (b) In case of any discrepancy immediately exchange the Question paper Booklet of same code by bringing the error to the notice of invigilator.
3. Use of Calculators, Mathematical Tables and Log books is not permitted.
4. **Candidate must ensure that he/she has received the Correct Question Booklet, corresponding to his/her branch of Engineering.**
5. **Candidate should ensure that the booklet Code and the Booklet Serial Number, as it appears on this page is entered at the appropriate place on the OMR Response Sheet by shading the appropriate circles provided therein using H.B. pencil only. Candidate should note that if they fail to enter the Booklet Serial Number and the Booklet Code on the OMR Response Sheet, their Answer Sheet will not be valued.**
6. **Candidate shall shade one of the circles 1, 2, 3 or 4 corresponding question on the OMR Response Sheet using H.B. Pencil only. Candidate should note that their OMR Response Sheet will be invalidated if the circles against the question are shaded using Black / Blue ink pen / Ball pen / any other pencil other than H.B. Pencil or if more than one circle is shaded against any question.**
7. One mark will be awarded for every correct answer. **There are no negative marks.**
8. The OMR Response Sheet will not be valued if the candidate :
   (a) Writes the Hall Ticket Number in any part of the OMR Response Sheet except in the space provided for the purpose.
   (b) Writes any irrelevant matter including religious symbols, words, prayers or any communication whatsoever in any part of the OMR Response Sheet.
   (c) Adopts any other malpractice.
9. Rough work should be done only in the space provided in the Question Paper Booklet.
10. No loose sheets or papers will be allowed in the examination hall.
11. Timings of Test: 10.00 A.M. to 1.00 P.M.
12. Candidate should ensure that he / she enters his / her name and appends signature on the Question paper booklet, leaflet attached to this question paper booklet and also on the OMR Response Sheet in the space provided. Candidate should ensure that the invigilator puts his signature on this question paper booklet, leaflet attached to the question paper booklet and also on the OMR Response Sheet.
13. Before leaving the examination hall candidate should **return both the OMR Response Sheet and the leaflet attached to this question paper booklet** to the invigilator. Failure to return any of the above shall be construed as malpractice in the examination. **Question paper booklet may be retained by the candidate.**
14. This booklet contains a total of **32** pages including Cover page and the pages for Rough Work.

MATHEMATICS

1. If ϕ satisfies $2\frac{dy}{dx}+4y=x^2$ and ψ satisfies $\frac{dy}{dx}+2y=x^3$ then $\phi+\psi$ satisfies

   (1) $3\frac{dy}{dx}+6y=x^2+x^3$ (2) $\frac{dy}{dx}+2y=x^2-x^3$

   (3) $2\frac{dy}{dx}+4y=x^2+2x^3$ (4) $\frac{dy}{dx}+2y=x^5$

2. If ϕ is a solution of $y'+iy=x$ with $\phi(0)=2$. Then $\phi(\pi)=$

   (1) π (2) $-\pi$ (3) $i\pi$ (4) $-i\pi$

3. A solution of $y'=\frac{e^{x-y}}{1+e^x}$ is given by $y=$

   (1) $\log(1+e^x)$ (2) $\log\left(\left|\log\left(1+e^x\right)\right|\right)$

   (3) $1+e^x$ (4) e^{1+e^x}

4. The general solution of $(2x+2y-1)dy=(x+y+1)dx$ is given by

   (1) $\log|x+y|+x-2y=c$ (2) $\log|x+y|-x+2y=c$

   (3) $\log|x+y|+2x-y=c$ (4) $\log|x+y|-2x+y=c$ (c is a constant)

5. The general solution of $y\,dx+\left(x+\frac{2y}{e^{xy}}\right)dy=0$ is

   (1) $e^{xy}-y^2=c$ (2) $e^{xy}+y^2=c$ (3) $e^{xy}-x^2=c$ (4) $e^{xy}+x^2=c$

6. The general solution of $y+2\left(\frac{dy}{dx}\right)^2=(x+1)\frac{dy}{dx}$ is

(1) $y+2c^2=(x+1)c$ (2) $y+2y^2=(x+1)y+c$

(3) $y+2y^4=(x+1)y^2+c$ (4) $y+2\sqrt{y}=(x+1)\sqrt{y}+c\,(y\geq 0)$ (c is a constant)

7. The general solution of $\frac{dy}{dx}-\frac{dx}{dy}=\frac{x}{y}-\frac{y}{x}$ is given by

(1) $(xy-c_1)(x^2-y^2-c_2)=0$ (2) $(xy-c_1)(x^2+y^2-c_2)=0$

(3) $(x^2y^2-c_1)(x-y-c_2)-0$ (4) $(x^2y^2-c_1)(x+y+c_2)=0$

8. The singular solution of $p=\log(px-y)$, where $p=\frac{dy}{dx}$ is $y=$

(1) $(x+1)\log x$ (2) $(x-1)\log x$ (3) $x(\log x+1)$ (4) $x(\log x-1)$

9. The solution of $(x^2-y^2)\,dx=2xy\,dy$ is

(1) $x(x^2+3y^2)=c$ (2) $x(x^2-3y^2)=c$

(3) $x^2(x+3y)=c$ (4) $x^2(x+3y)=c$ (c is a constant)

10. The integrating factor of $(x+1)\frac{dy}{dx}-y=e^{3x}(x+1)^2$ is

(1) $x+1$ (2) $(x+1)^2$ (3) $\frac{1}{x+1}$ (4) $\frac{1}{(x+1)^2}$

11. A solution of $(D^3+D^2+5D+5)y=0$ where $D=\frac{d}{dx}$ is

(1) $y=\sin x$ (2) $y=\cos x$ (3) $y=e^x$ (4) $y=e^{-x}$

12. Particular integral of $(D^2+5D+6)y=2\sinh x$ is

(1) $y=\frac{1}{12}(e^{-x}+6e^{x})$ (2) $y=\frac{1}{12}(e^{x}+6e^{-x})$

(3) $y=\frac{1}{12}(e^{-x}-6e^{-x})$ (4) $y=\frac{1}{12}(e^{x}-6e^{-x})$

13. The solution of $(D^2 - 2D - 3)\,y = 0$ is $y =$

(1) $c_1e^x + c_2e^{3x}$ (2) $c_1e^{-x} + c_2e^{-3x}$ (3) $c_1e^x + c_2e^{-3x}$ (4) $c_1e^{-x} + c_2e^{3x}$

14. The solution of $(D^2+4)\,y=0$ is given by $y =$

(1) $c_1e^{2x} + c_2e^{-2x}$ (2) $c_1e^{2x} - c_2e^{-2x}$

(3) $c_1\cos 2x + c_2 \sin 2x$ (4) $c_1\cos 4x + c_2 \sin 4x$

15. Particular integral of $(D-3)^2\,y=e^{3x}$ is

(1) $\frac{x^2}{2}e^{3x}$ (2) $\frac{x^2}{3}e^{3x}$ (3) $\frac{x^2}{3!}e^{3x}$ (4) $\frac{x}{2}e^{3x}$

16. The complementary function of $(D^2-2D+2)\,y = \sin x$ is

(1) $e^x(c_1 \cos x + c_2 \sin x)$ (2) $e^{-x}(c_1 \cos x + c_2 \sin x)$

(3) $e^{-x}(c_1 \sinh x + c_2 \cosh x)$ (4) $e^x(c_1 \cosh x + c_2 \sinh x)$

17. Particular integral of $(D^2+1)\,y = e^{2x} \cos 3x$ is $\frac{e^{2x}}{40}\phi(x)$ where $\phi(x) =$

(1) $3 \sin 3x + \cos 3x$ (2) $3 \sin 3x - \cos 3x$

(3) $\cos 3x - 3 \sin 3x$ (4) $-3 \sin 3x - \cos 3x$

18. The particular integral of $(D^2-1)\,y = x \sin x$ is

(1) $\frac{1}{2}(x \sin x + \cos x)$ (2) $\frac{1}{2}(\sin x + x \cos x)$

(3) $-\frac{1}{2}(x \sin x + \cos x)$ (4) $-\frac{1}{2}(\sin x + x \cos x)$

19. The differential equation $\left(\frac{dy}{dx}\right)^2 + xy^2 = 0$ is

(1) linear (2) homogeneous

(3) of second order (4) of second degree

20. The general solution of $\frac{d^2y}{dx^2} - 2\alpha\frac{dy}{dx} + \alpha^2 y = 0$ is such that one term contains $e^{\alpha x}$ then its second term contains a constant times

(1) $e^{-\alpha x}$ (2) $xe^{-\alpha x}$ (3) $xe^{\alpha x}$ (4) $\frac{x^2}{2}e^{\alpha x}$

21. The G.C.D of 396 and 128 is

(1) 2 (2) 4 (3) 6 (4) 8

22. If (a, b) = 1 then (a + b, a – b) is

(1) 2 (2) 3 (3) 4 (4) 5

23. If $F_n = 2^{2^n} + 1$ is the n^{th} Fermat number then

(1) F_3 is composite (2) F_4 is composite
(3) F_5 is composite (4) F_2 is composite

24. The congruence $5x \equiv 3 \pmod{24}$ has

(1) no solution (2) two solutions
(3) infinite number of solutions (4) unique solution

25. If n is an integer ≥ 2 and $(n-1)! \equiv -1 \pmod{n}$ then n is

(1) 2 (2) composite (3) a prime (4) a square

26. $\div$ is a binary operation on

(1) set of positive integers (2) set of integers
(3) set of rational numbers (4) set of non-zero rationals

27. The number of binary operations on a set of n elements is

(1) n^n (2) n^{n^2} (3) $(n^2)^n$ (4) $(n^n)^n$

28. In the group $(I,\circ)$ where I is the set of integers and $a \circ b = a+b+1$ for all a,b in I. The identity element is

(1) 0 (2) 1 (3) -1 (4) -2

29. If every element of the group G is its own inverse then G is

(1) non abelian (2) abelian (3) cyclic (4) the trivial group $\{0\}$

30. If A and B are subgroups of a group G then $A \cup B$

(1) is an abelian subgroup of G (2) is a non-abelian subgroup of G
(3) need not be a subgroup of G (4) is equal to G

31. If $\alpha = (2\ 5\ 3)\ (4\ 7)\ (1\ 0\ 9\ 8)$ is a permutation of the set $\{1,2,3,4,5,6,7,8,9\}$ then its order is

(1) 3 (2) 6 (3) 9 (4) 12

32. In the group $(S_3, \bullet)$, the number of elements whose inverse is itself is

(1) 2 (2) 3 (3) 6 (4) 4

33. The number of generators in $(Z_{10}, +_{10})$ is

(1) 1 (2) 2 (3) 4 (4) 5

34. Every cyclic group of infinite order is isomorphic to

(1) multiplicative group of positive rationals
(2) additive group of integers
(3) additive group of even integers
(4) $S = \{1, -1\}$ with usual multiplication as binary operation

35. ϕ is a homomorphism of the group G into the group G' whose identity elements are e and e' respectively then

(1) $\phi(e) = e'$ and $\phi(x^{-1}) \neq \{\phi(x)\}^{-1}$ for all x in G
(2) $\phi(e) \neq e'$ and $\phi(x^{-1}) = \{\phi(x)\}^{-1}$ for all x in G
(3) $\phi(e) = e'$ and $\phi(x^{-1}) \neq \{\phi(x)\}^{-1}$ for some x in G
(4) $\phi(e) = e'$ and $\phi(x^{-1}) = \{\phi(x)\}^{-1}$ for all x in G

36. A homomorphism ϕ of a group G into the group G' is an isomorphism if
(1) G' is a proper subgroup G (2) G is a proper subgroup of G'
(3) $\ker \phi$ is the identity element of G (4) $\ker \phi$ is the identity element of G'

37. If aH and bH are two left cosets of a group G and $aH \neq bH$ then $aH \cap bH =$
(1) {a, b} (2) H (3) G (4) ϕ

38. G is a finite group and H is a subgroup of G such that there is no other subgroup of G whose order is the order of H then H is
(1) abelian (2) cyclic (3) normal (4) G

39. If N, M are the normal subgroups of a group G then NM/M is isomorphic to
(1). MN/N (2) N (3) $N/N \cap M$ (4) $M/N \cap M$

40. An automorphism of a group G is an isomorphism of G
(1) onto a proper subgroup of G (2) onto a super subgroup of G
(3) onto a trivial subgroup of G (4) onto G

41. If $\vec{a}$ is a constant vector and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ then $\nabla(\vec{a}.\vec{r}) =$
(1) $\vec{0}$ (2) $\vec{a}$ (3) $\vec{r}$ (4) $\vec{i} + \vec{j} + \vec{k}$

42. If $\vec{r}$ is the position vector of an arbitrary point then $\nabla.\vec{r} =$
(1) 0 (2) 1 (3) 2 (4) 3

43. If $r = \left(x^2 + y^2 + z^2\right)^{1/2}$ then $\nabla^2\left(\frac{1}{r}\right) =$
(1) 0 (2) 1 (3) 2 (4) 3

44. The value of n for which the vector $r^n\vec{r}$ where $r=|\vec{r}|$ is solenoidal is

(1) 0 (2) -1 (3) -2 (4) -3

45. The derivative of $\phi(x,y,z)=x^2-2xy+z^2$ at $(2,-1,1)$ in the direction of $\vec{i}-2\vec{j}+2\vec{k}$ is

(1) 6 (2) 4 (3) 2 (4) 1

46. The value of $\iint\left(x^2\vec{i}+y^2\vec{j}+z^2\vec{k}\right)dS$ over the faces of the cube given by $0\le x,y,z\le 1$ is

(1) 3 (2) 2 (3) 1 (4) 0

47. If $\vec{V}=\left(3x^2+6y\right)\vec{i}-14yz\vec{j}+20xz^2\vec{k}$ then $\int_C \vec{V}.dV$ where C is the straight line joining (0, 0, 0) and (1, 1, 1) is

(1) $\frac{10}{3}$ (2) $\frac{11}{3}$ (3) 4 (4) $\frac{13}{3}$

48. In the usual notation, if S is the surface of the unit sphere and $\int_S (ax\vec{i}+by\vec{j}+cz\vec{k}).\vec{n}\,dS=\frac{\lambda}{3}\pi(a+b+c)$ then $\lambda=$

(1) 2 (2) 4 (3) 1 (4) 3

49. The circulation of $\vec{F}(x,y,z)=y\vec{i}+z\vec{j}+x\vec{k}$ around the circle $x=\cos\theta$, $y=\sin\theta$ and $z=0$ is $\lambda\pi$ where $\lambda=$

(1) 0 (2) 1 (3) -1 (4) 3

50. The value of $\oint_c(2ydx+xdy)$ where C is $x^2+y^2=4$ is $\lambda\pi$ then $\lambda=$

(1) -2 (2) 2 (3) -4 (4) 4